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ABSTRACT

This teachers guide contains information and activities to provide 5th-grade students with a hands-on experience with air, land, and water pollution in Illinois. This booklet incorporates previous documents entitled: "Water the Liquid of Life," "The Land We Depend On," and "The Air We Breathe." The materials are designed to develop research, problem-solving, reading, writing, mathematical, experimental, analytical, and artistic skills. Topics include: air, water, and land quality, drinking water, nonpoint source pollution, wetlands, ozone, global warming, waste management, hazardous waste, leaking underground storage tanks, household hazardous waste, trees, coal, environmental laws and regulations, tires, recycling, composting, and ethanol. Appendices include a correlation with the Illinois State Goals for Learning, glossary, and worksheet answers. An accompanying activity book contains activities organized to match the chapters in the teacher guide. Contains 36 references. (MKR)

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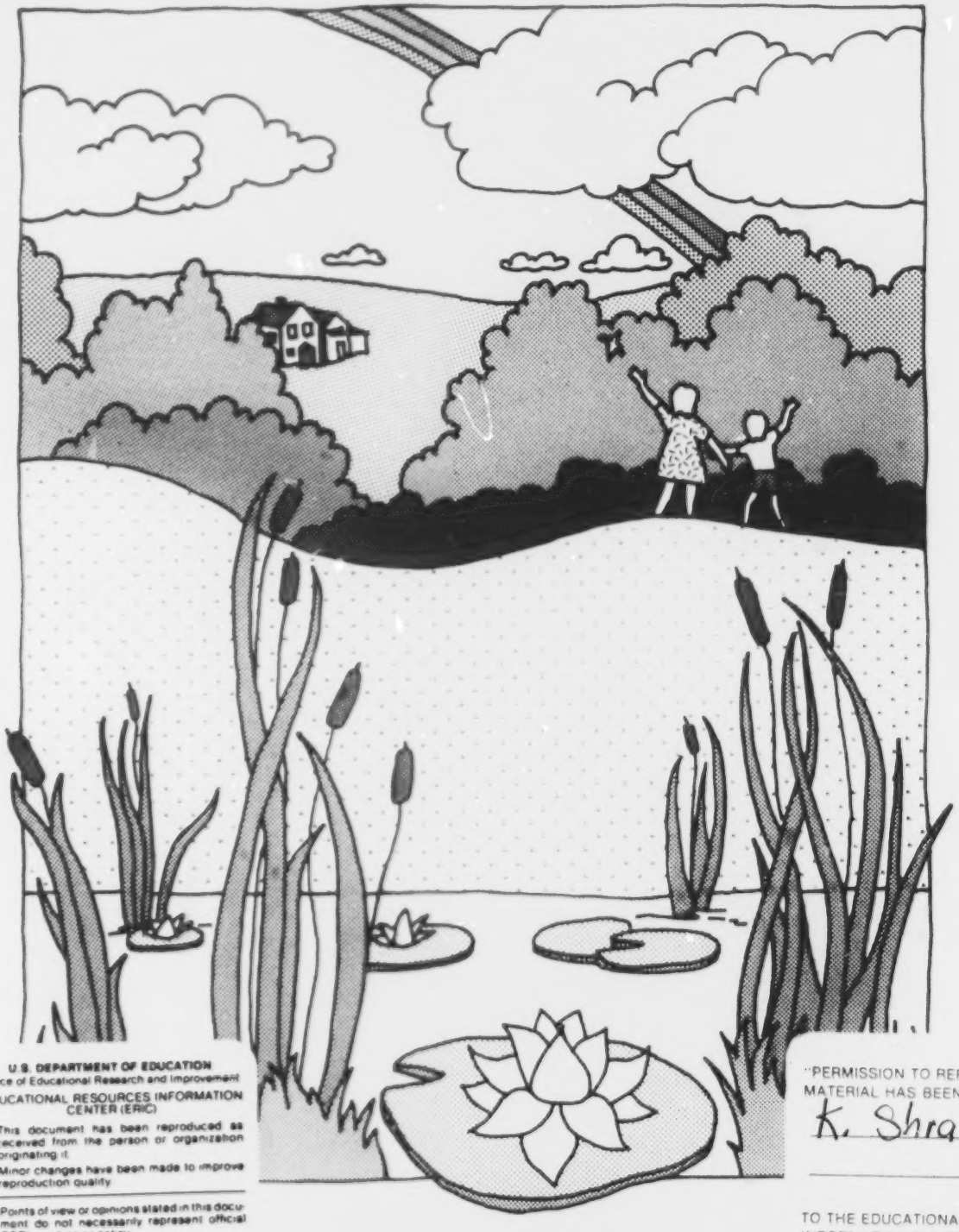
We Depend on
Illinois' Environment

ED 404 120



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Illinois Environmental Protection Agency

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Dear Fifth Grade Teachers and Students:

Thank you for participating in "We Depend on Illinois' Environment," the Illinois Environmental Protection Agency's Fifth Grade education program. I am a strong proponent of environmental education because I know that it is the youth of today who will be the engineers, geologists, biologists, chemists, lawyers, and environmental policymakers of tomorrow.

This education packet contains information and activities that give students a hands-on experience with air, land, and water pollution in Illinois. This is only part of the IEPA's efforts on environmental education. In 1992, Governor Jim Edgar started the Governor's Environmental Corps, an internship program of high school and college students where they work at the agency and gain environmental experience. There is also a Junior Environmental Corps where agency employees work with girl scouts, boy scouts, and youth camps in the summer to teach them how to protect our natural resources.

The agency is also heavily involved in volunteer lake monitoring, presentations at elementary schools, and many activities related to the annual Earth Day celebration. If you want any information or help on your education activities, please contact us at 217-782-5562, and we will do our best to assist you.

Remember also, you can do your part to help the earth. Recycle what you can and don't throw litter in rivers or lakes. To prevent air pollution, walk or take your bicycle whenever possible.

Thank you again for your work. The agency depends on you to protect Illinois' environment.

M. A. Gade

Mary A. Gade

We Depend on
Illinois' Environment - Manual

Fifth Grade

(Materials may be duplicated for classroom/activity use)

Office of Public Information

Illinois Environmental Protection Agency
2200 Churchill Road, P.O. Box 19276
Springfield, IL 62794-9276
217/782-3397

1994

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Teachers' Guide

Welcome to the Illinois Environmental Protection Agency's environmental education program, "We Care About Illinois' Environment." We hope that you and your students learn a great deal about the air, water, and land in Illinois.

The materials included are designed to develop research, problem-solving, reading, writing, mathematical, experimental, analytical, and artistic skills. The materials can be used as a free-standing unit or can be integrated into the framework of other curricula. All materials included in the packet may be duplicated for teacher/student use. To aid with the integration with the curriculum, the education packet has been correlated with the Illinois State Goals for Learning. This correlation guide is found at the end of the packet.

The packet is not designed to require that it be used in its entirety or within a fixed time period. Rather, it offers a variety of information, experiments, projects, games, and other activities from which you may select those most appropriate for your students. We do ask that you use the packet during the month of January in order to produce material in conjunction with the deadline for the art and prose contest.

It is the goal of the IEPA that teachers, by using the packet, will be able to foster knowledge of the environment, as well as improve understanding of the impact that our everyday activities have on the environment.

The following information is being provided to teachers to help in their endeavors of promoting environmental awareness in their classrooms:

What is environmental education?

Simply defined, environmental education is education about the environment, education for (the preservation of) the environment, and education in the environment. Environmental education deals with human relationships with natural and manmade surroundings and includes the relations of such aspects of the environment as natural resources, population, conservation, transportation, technology, and wildlife to the total environment. Environmental education is concerned with knowledge of environmental problems, awareness of possible solutions, and motivation to work toward solutions that not only ensure our survival, but improve the quality of life on earth.

What are the goals of environmental education?

The goals of environmental education are divided into five categories:

Awareness- to help social groups and individuals acquire an awareness of and sensitivity to the total environment and its allied problems.

Knowledge- to help social groups and individuals gain a variety of experience in, and acquire a basic understanding of, the environment and its associate problems.

Attitudes- to help social groups and individuals acquire a set of values and feelings of concern for the environment, and the motivation for actively participating in environmental improvement and protection.

Skills- to help social groups and individuals acquire the skills for identifying and solving environmental problems.

Participation- to provide social groups and individuals with an opportunity to be actively involved at all levels in working toward resolution of environmental problems.

What are some guiding principles of environmental education to use in order to accomplish these goals?

Environmental education should:

1. consider the environment in its totality- natural and built, technological and social (economic, political, cultural-historical, moral, aesthetic);

2. be a continuous lifelong process, beginning at the preschool level and continuing through all formal and non-formal stages;

3. be interdisciplinary in its approach, drawing on the specific content of each discipline in making possible a holistic and balanced perspective;

4. examine major environmental issues from local, national, regional and international points of view so that students receive insights into environmental conditions in other geographical areas;

5. focus on current and potential environmental situations while taking into account the historical perspective;

6. promote the value and necessity of local, national, and international cooperation in the prevention and solution of environmental problems;

7. relate environmental sensitivity, knowledge, problem-solving skills and values clarification to every age, but with special emphasis on environmental sensitivity to the learner's own community in early years;

8. help learners discover the symptoms and real causes of environmental problems;

9. emphasize the complexity of environmental problems and thus the need to develop critical thinking and problem-solving skills; and

10. utilize diverse learning environments and a broad array of educational approaches to teaching/learning about, and from, the environment with due stress on practical activities and firsthand experience.

Environmental Values

Values are human preferences and moral decisions which usually lead to certain behaviors. They guide choices and are usually reflected in a person's lifestyle. Environmental values are a part of all values which consider the care and use of natural resources and maintenance of ecological cycles. These values are sometimes in competition with other values such as human comfort, convenience, safety, sanitation, or enjoyment. It is not possible to act upon environmental values all of the time.

Educational activities can be designed to encourage the awareness, analysis, and possible change of these values. "Teaching" an environmental value does not imply forcing it on students. A better approach is to provide the proper conditions for a meaningful indoor or outdoor experience which may result in the realization of a new value or the modification or reaffirmation of one presently held.

Carl Rogers, the late educator and psychotherapist, proposed that persons who move toward greater openness and sharing of their experiences, arrive at a commonly held set of values which enhance self, community, and the survival of the human species. This belief that the study, discussion, debate, and resolution of conflicts centered around environmental

issues will result in a set of values that sustain the earth is the key to values education. The following ideas can accomplish these goals without imposing a set of "right" values upon students.

Clarification- Structured activities involving groups of people can promote interactions and bonding with the environment and can reveal a diversity of value positions. Opportunities to freely choose, and act in relation to the environment, can clarify values. For example, finding a variety of litter and assessing its impact upon humans can focus upon the process of valuing.

Writing- Writing exercises based on environmental issues and experiences can lead to values development. Writing forms such as poetry, figures of speech, journals, or short stories can strengthen and form values.

Action Projects- Many hands-on projects directed toward solving or minimizing environmental problems can affect values. For example, activities such as cleaning up litter, controlling erosion, or planting trees can transform perceived values into repeated patterns of action.

Games and Simulations- Role playing is a powerful tool for shaping values. Games and simulations that use elements from nature, demonstrate ecological relationships, or pose environmental dilemmas can contribute to the process of valuing, especially when they are reflected upon and shared.

Reading- Poems and stories can serve as springboards and sources of motivation for valuing experiences. Written text by authors such as Dr. Seuss, Robert Frost, Aldo Leopold, and many others can provide stimuli for values development.

Asking Questions- Sometimes by asking the right questions people can become clearer about their values. Activities can be developed using questions as the main component or as follow-ups to a structured experience.

Finding Examples- One teaching technique is to provide learners with a list of value terms and to ask students to find examples of them in the environment. For example, these value terms can cover such areas as harmony, good/bad changes, balance, useful plants/animals (Are all plants and animals useful?), or categories such as nature as a teacher, creative force, or something to control.

Using the Outdoor Classroom

Modern education places many demands on teachers and students alike. In the urgency for teachers to teach more and faster, there is a growing assumption that the building classroom is the only place where legitimate learning can take place. The result of this tendency is increasingly to abandon the outdoor classroom; many opportunities and experiences are missed when the outdoors is not used as a classroom.

Many of the activities in this packet can be enhanced when conducted outdoors. Research has shown that effective learning is often heightened in natural settings. The natural context- the environment and people's interactions with it- is the subject for most of the education packet's activities. The school ground, a nearby park, a pond, a small stream, a vacant lot, and sites visited on extended field trips may all serve to enhance learning when incorporated within instructional experiences. It seems increasingly important, in this urbanized age where much information comes to us vicariously and abstractly, to make sure that students have meaningful, firsthand experiences with the living world.

Such natural explorations lead students to understand and remember important concepts. With confidence gained first hand in relatively small scale, local field experiences, stu-

dents can more effectively embrace ideas that involve the environment in a global sense.

Another benefit gained from outdoor experience is that it provides the foundation for life-long learning. More and more leisure activities take advantage of the outdoors. Bird watching, hiking, photography, and drawing are all becoming increasingly popular. Students who are grounded in outdoor studies are more apt to continue active learning past school.

Using the outdoors as a classroom can take many forms. It may be as simple as using the windows and windowsills of the building classroom to observe what's outside. School grounds and urban parks offer a variety of study opportunities. Getting outside and learning about the environment does not require the capacity to drive great distances.

Evaluating and Assessing Student Learning

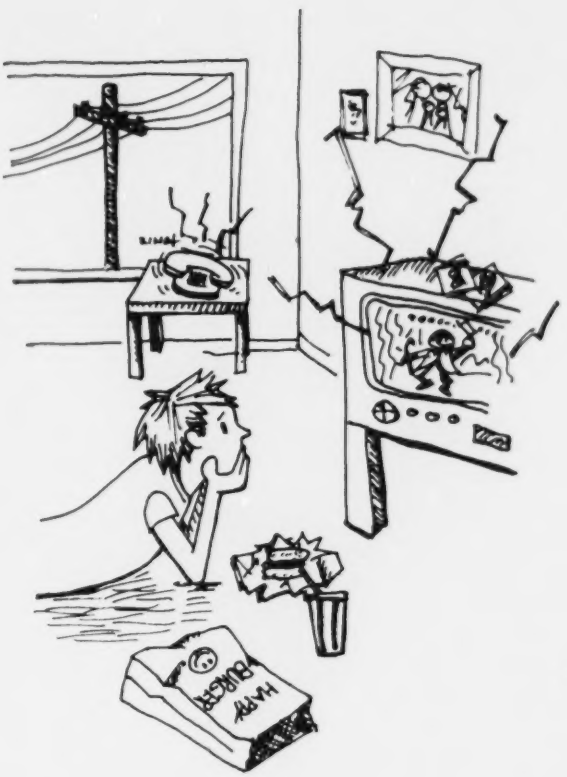
After completing the education packet, there are a variety of ways to evaluate and assess student competence. Many teachers are seeking ways to show that their students can go beyond the recitation of facts. They are asking students to demonstrate a mastery of high order thinking skills in the context of their classroom activities.

The following is a list of evaluation techniques that may meet your classroom needs to assess student understanding of the packet information: dramatization, news reporting, journal writing, visual representation, students teaching students (peers or younger students), position statements, real world examples, game making, and peer testing.

The IEPA hopes you have great success in using our education packet, "We Depend on Illinois' Environment," and that this teacher guide is an aid to that success. The purpose of this packet is to provide information about the environment and to help students make responsible choices and decisions to protect the air, water, and land in Illinois for the present and the future. Please contact Christy Northrop at 217/782-3362 or Gloria Ferguson at 217/782-5562 if you have questions about the packet or education program.

1

Earth's Closed System



Your birth made an impact on the world. You were a new person for the world to feed, clothe and shelter.

Today, you are still making an impact on the world. When you turn on the TV or turn up the heat in your home, you use energy - gas, oil, or electricity. When you bite into a hamburger from a fast food restaurant, you benefit from the work of the farmers who raised the cattle and the industries that made the hamburger packaging. The farmers, industries, and fast food restaurants also used energy to produce the hamburger.

The way that people produce food, energy and other **resources** you enjoy can keep your **environment** safe and clean, or make it dirty and polluted.

The way that you use these resources can also affect the environment. You decide what products to buy, what to repair and what to throw away. As you grow up, you will also decide about laws. Your decisions can make the environment better or worse.

Many of the things that we do create environmental problems and cause pollution. Pollution is whatever makes our air, land, and water dirty and unhealthy.

Burning fuel to make electricity for houses and factories can pollute the air we breathe by filling it with smoke, dirt and **chemicals**. Mining for coal and other materials to make the things we buy can pollute the water. For example, rain can wash soil and **acids** from mines into nearby rivers and lakes.

Waste from factories and disposal of garbage can pollute land, water and air. Chemicals sprayed on crops and added to food, detergents, and cleaning products can all be harmful.

Many of the things we do and want cause pollution. Whether or not we pollute the environment depends on how we produce and use the things we want.

A Closed System

You have something in common with dinosaurs that lived millions of years ago, with Egypt's King Tut, who lived thousands of years ago, and with Britain's Queen Elizabeth, who is living today.

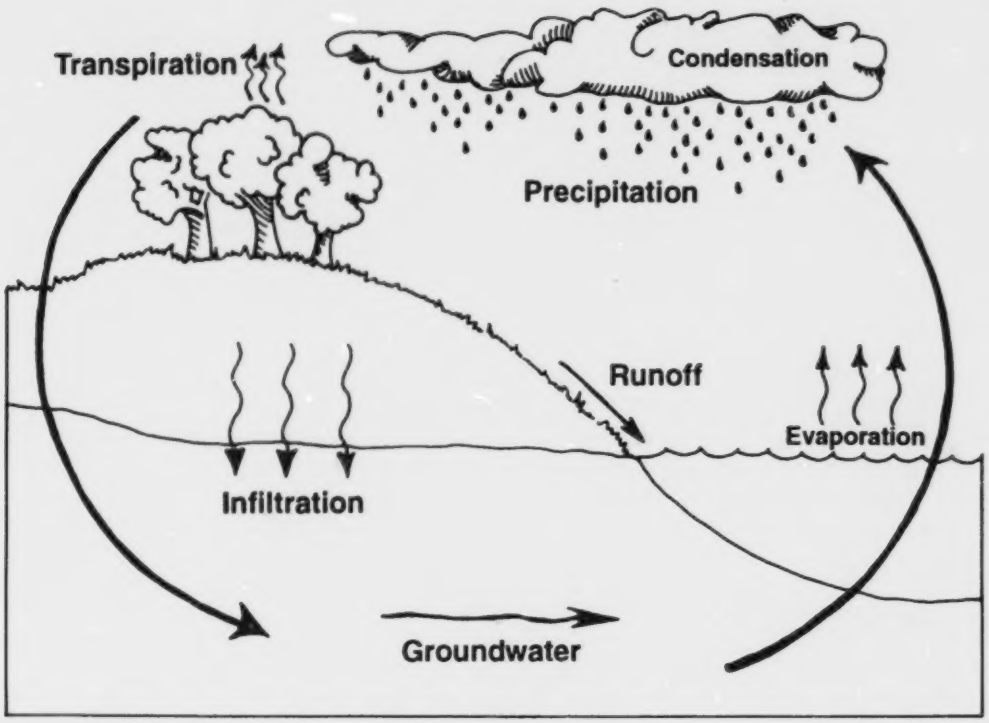
The water you drink today may be the same water drunk by dinosaurs, and your favorite person in history may have breathed some of the same air you are breathing now.

It seems incredible that people and animals so far apart in time and space could share anything at all. But anyone who has ever lived has breathed the same air and has used the same water that you use today and your children will use in the future.

This is because earth is a **closed system**. Earth is sealed off from space much like a spaceship. The air, water and land now on earth have always been here and will still be here a thousand years from now. Earth gets no new supplies from space.

Nature uses air, water, and land again and again. This is called recycling. Energy in the form of sunlight provides the power for recycling by nature.

Take water, for example. It falls to the ground as rain or snow. From there some of the water soaks deep into the ground and becomes groundwater. Some runs off the land into rivers and lakes and becomes surface water. Sooner or later both the surface water and much of the groundwater reach the ocean. At the surface of the ocean and the land, heat from the sun **evaporates** water. It rises as vapor into the air to make clouds. Eventually, the very same water falls back to earth as rain or snow, and the **water cycle** begins again.



When you pour a glass of water down the drain in your house, it goes through underground pipes, and eventually rejoins the never-ending cycle of water from land to air and back again.

The same is true of the air we breathe. No new air is ever added to the earth. Instead, green plants clean or recycle air. To grow, plants use sunlight, water and the carbon dioxide that people and other animals breathe out, and they produce the oxygen we need to breathe in. This process is known as photosynthesis. Plants turn carbon dioxide, a gas in the air, into food in plants through photosynthesis. Oxygen is one of the waste materials plants release when they make their food. The oxygen goes into the air. All living things need oxygen. Without green plants, the oxygen in the air would be used up.

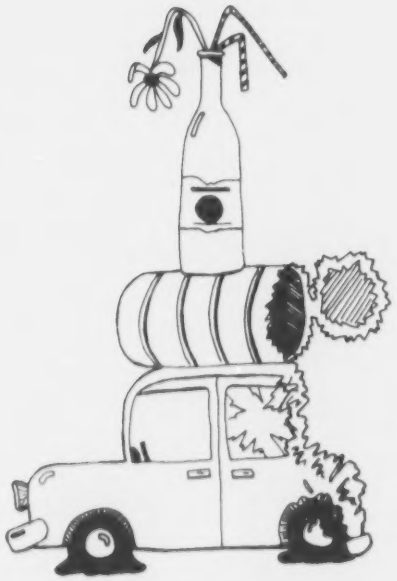
Wood, cotton and other materials produced by living things are broken down into atoms (simpler particles) by microscopic plants and animals (**bacteria** and **fungi**). We call these materials **biodegradable**. The atoms are recycled into new materials. For example, the atoms may become **minerals** that plants soak up through their roots.

But in the last hundred years or so, things have become more complicated. Some materials that are made by people cannot be recycled by nature. These manmade materials include many plastics, detergents and chemicals. They cannot be eaten by insects, bacteria, fungi or any other living thing.

Thrown away in the trash, dumped into water or carelessly sprayed in the air, these manmade materials do not biodegrade. Instead, they remain as they are and some can pollute the environment.

There are still other materials, such as iron, aluminum and glass that are recycled in nature, but very slowly. The soda cans and junk cars that **litter** our country are made from these materials and can cause environmental problems.

The number of people on earth is always growing. More people need more things: more food, water, homes, cars and energy. Making these things will produce more pollution, unless people control it. So it is important to remember one thing: *if people create pollution, they can also control and* ***prevent*** *it.*



Worksheet

Name _____

EARTH'S CLOSED SYSTEM

New Words - Use six of the following words to fill in the blanks below. Use the six remaining words to make your own sentences and write them on the back of the worksheet. Use the chapter and the Dictionary of Environmental Terms to help you to define the words.

closed system	**surface water**	**environment**
litter	**recycle**	**pollution**
plastics	**resources**	**water cycle**
groundwater	**biodegradable**	**photosynthesis**

Fill-in-the-Blanks

1. _____ is whatever makes our air, land and water dirty and unhealthy.

2. A system such as the earth which can not receive new air, water or land is a _____ .

3. Materials that cannot be recycled by nature include _____ , detergents and chemicals.

4. Materials that can be broken down by microscopic plants and animals are _____ .

5. _____is the supply of water under the earth's surface.

6. The _____ is everything, including living things, that surrounds a person, animal, or plant.

Short Answer

1. What are some causes of air, water and land pollution?

2. What do you have in common with King Tut?

3. How is water recycled?

4. What would happen if photosynthesis stopped?

Write your own Sentences

1.

2.

3.

4.

5.

6.

2

Life Depends on Air, Water, and Land

Air, water and land are important parts of the environment. All three are required for humans and life in general. Each has important functions in the environment which together continue the cycle of life on earth.

The Air We Breathe

No matter where you go or what you do, there is something that you have in common with every other living person. When you are walking to school or eating lunch, you are doing it. You do it whether you are awake or asleep. You are doing it right now.

You are breathing. Whether outside playing or in the classroom learning, everyone has to breathe. In your lifetime you will breathe about 625,000,000 times. What will you be breathing? Air.

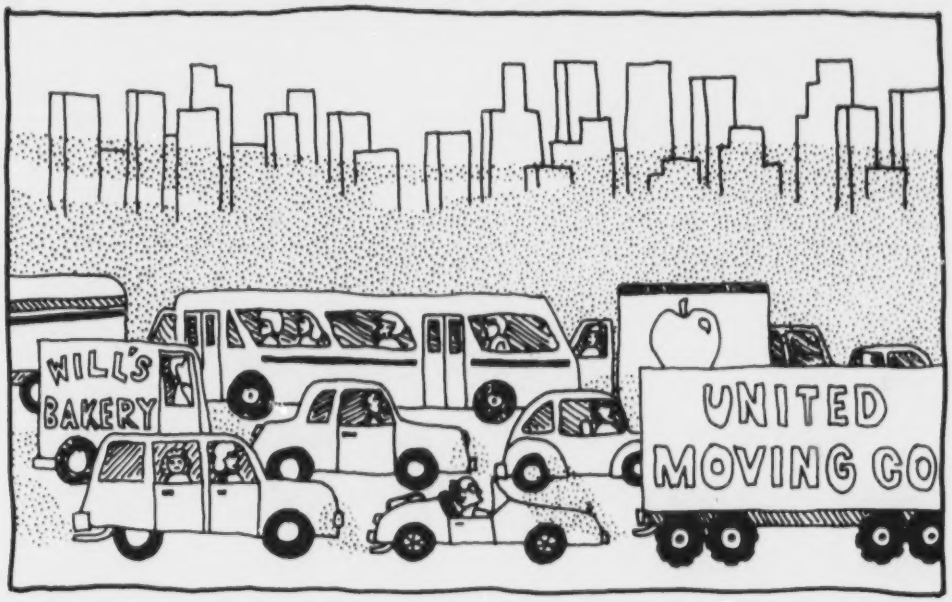
Clean air is a mixture of different gases which have no smell. Air is mostly made up of **nitrogen** and oxygen but with small amounts of **water vapor**, **argon**, carbon dioxide, **neon**, **helium** and **hydrogen** (*See Handout 2A, The Parts of Air*).

On a nice, clear day your supply of air seems to be endless. The skies stretch as far as you can see. However, that doesn't mean that you can safely pollute the air. Clean air is very important. Take away your supply of air and you could live for only a few minutes. Air is one of our most valuable resources.

Unfortunately, there is pollution in the air we breathe. Air pollution occurs when harmful things are released to the air.

These harmful things are called pollutants and they come from many things. Even you can cause air pollution.

School buses and your family's car can produce **emissions** that can pollute the air. The factories that make things such as desks, books and bicycles can also produce more emissions that go into the air. In fact, all over the



world millions of cars and factories give off **soot**, ashes and chemicals that pollute the air.

Still more of these pollutants come from things that people do every day. Here is a list of common things which pollute the air:

- Burning paper, leaves and garbage
- Heating homes with wood, coal and oil
- Using air conditioners
- Smoking cigarettes, pipes and cigars
- Driving cars, trucks, motorcycles, and motor boats
- Flying airplanes
- Tearing down buildings
- Cooking on outdoor grills
- Using lawnmowers

All of these activities can pollute the air. Sometimes you can smell the pollution, and sometimes, when the air looks hazy or smoky, you can see the pollution. Other times, air pollution is odorless and invisible.

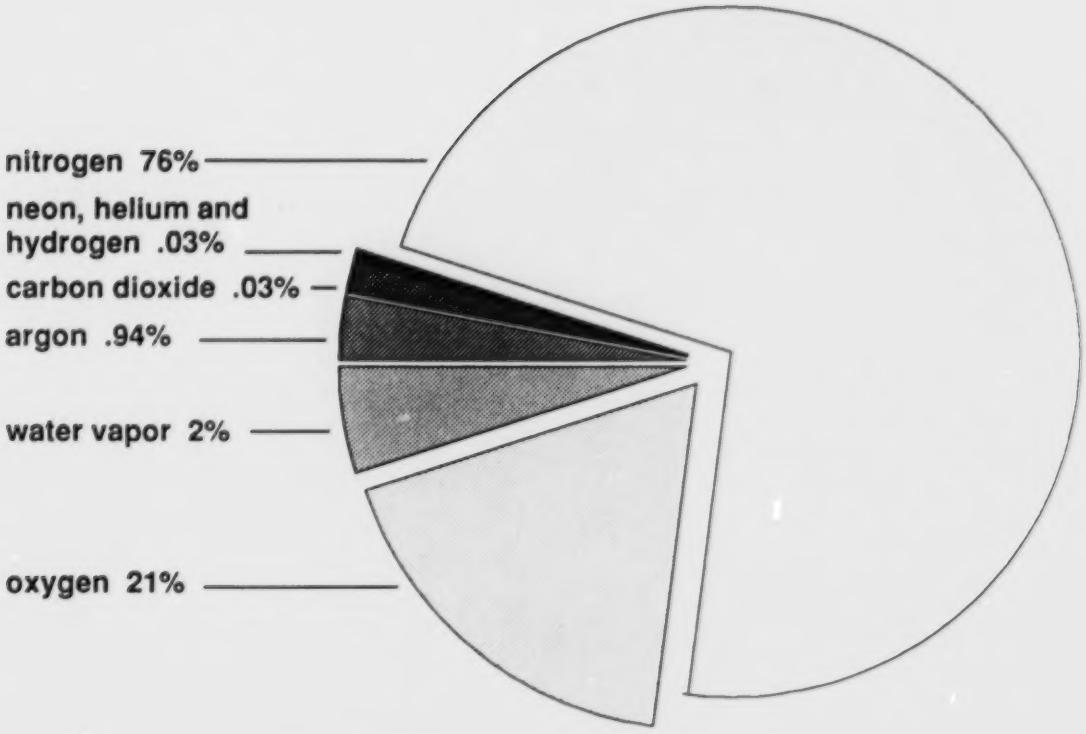
Air pollution, invisible or not, can cause a lot of damage. Even a little air pollution can make your eyes burn and your head ache. Air pollution can blur

your vision, make you dizzy, and/or make you tired. Many people find it difficult to breathe when pollution is in the air. Air pollution can even make it easier for you to catch a cold or the flu, and some air pollutants have been linked to serious diseases such as lung cancer and heart trouble (*See Handout 2B, Air Pollution and Human Health*).

People aren't the only things that are hurt by air pollution. Animals, plants and even buildings can be affected. Plants surrounded by polluted air may not grow, and fish and animals may die. Statues and building materials can be discolored or **corroded**.

Handout 2A

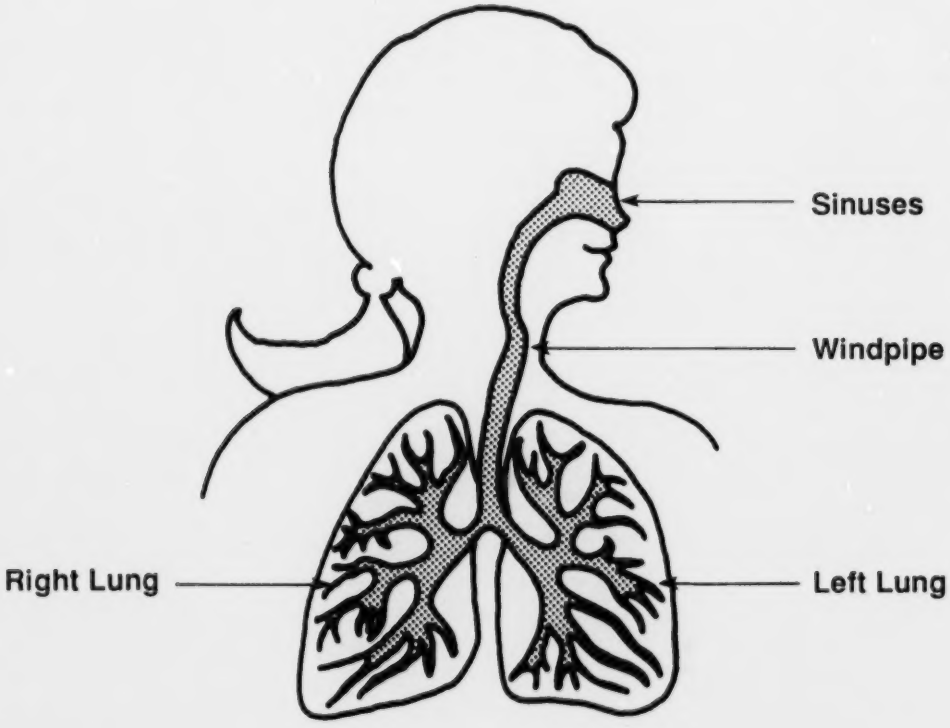
The Parts of Air



Clean air is a mixture of odorless gases, of which nitrogen and oxygen make up 97% . Small amounts of water vapor, argon, carbon dioxide, neon, helium, and hydrogen make up the other 13%.

Handout 2B

Air Pollution and Human Health



Polluted air can make you sick. When pollution is in the air it can enter your body each time you take a breath.

The pollution can make your nose sting and cause you to sneeze. As polluted air fills your lungs the pollution will begin to irritate your entire respiratory system. You may feel as if someone is squeezing your chest and you may even begin to cough. A runny nose and headaches are additional symptoms of breathing polluted air.

If you breathe polluted air for a long time you may develop serious health problems. The people who are most affected by the polluted air are very young children, old people and people who have allergies.

Water: The Liquid of Life

Though it is the most common substance found on earth, water should never be taken for granted. You can't live without it; it is truly the "liquid of life." Your own body is two-thirds water. To stay healthy, you need to take in two and a half quarts of water a day; you get most of this from the food you eat and all the things you drink such as juice, milk and soft drinks. Take away your supply of water and you could only live for a few days.

Water is needed, as well, to produce food. Farmers must have water to grow crops and raise animals. It's hard to believe, but it takes about 15 gallons of water to grow the wheat to make one loaf of bread, about 120 gallons to care for a chicken to lay one egg, and about 4,000 gallons to produce a pound of beef.

You need water for bathing, washing clothes and dishes, and brushing your teeth (*See Handout 2C, How Much Water Does It Take*). Factories must have water to make all kinds of things you and your family use, like the clothes you wear, the paper in this packet, the gasoline in the family car, electricity for your school and home and even the steel, plastic and glass used to make a car.

People use water for swimming, boating and fishing. Ships carry people and goods across the oceans and seas and on rivers and lakes. Many plants and animals live in water.

There is a lot of water on earth. In fact, 80 percent of the earth's surface is covered with water, but only a tiny part of it is usable as drinking water. Ninety-seven percent of the earth's water is salt water, in oceans and seas; another two percent is frozen. That means only one percent of the water on earth is suitable for drinking, and not all of it is easy to reach. We're all familiar with surface water such as lakes and rivers, but much of the water people use exists out of sight underground. It is harder to reach this groundwater than surface water.

Water can change its form. In fact, water is the only substance on earth which can be found naturally in three separate forms- liquid, solid and gas. While a single drop of water may at different times float overhead as a vapor or hang in the air as steam (gas), fall to earth as rain (liquid), and then freeze into ice, sleet or snow (solid), it cannot form new water. Through the water cycle, it is recycled, over and over, through its three forms (*See Handout 2D, The Water Cycle*).

Water can be polluted when untreated **sewage** and other wastes are dumped into it. Polluted water can smell, have garbage floating in it, look muddy and be too ugly to swim or boat in. But even water that looks clean and smells good can be polluted. It may be loaded with germs and dangerous chemicals that you cannot see.

People pollute in a lot of ways. One way is to allow factory and bathroom wastes to flow through pipes and into waterways such as rivers and lakes with no **treatment**. Another way is to allow soil, fertilizers and pesticides to wash from farms into waterways. Soils can also be washed from building and

mining sites, and oil and other chemicals can be washed from city streets into waterways after a rain. Bacteria can feed on some wastes, and other wastes will be diluted by the water so they are not harmful. But nature can only do so much!

Today, many **toxic** or potentially dangerous chemicals threaten the cleanliness and safety of our water supplies. Although these chemicals can be useful in industry and agriculture, they may pose a health risk even in small amounts. Chemicals can enter our drinking water supply from urban and rural applied pesticides, herbicides and fertilizers, dumps and landfills, leaking underground storage tanks, industries, mining, and petroleum companies. Pollutants can be bacteria and other organisms found in human and animal waste that cause diseases such as **cholera**, or they can be toxic metals such as **mercury** and **lead** that cause serious health problems.

Handout 2C

How Much Water Does it Take?

A typical household in the United States uses 240 gallons a day.

5 to 7 gallons to flush a toilet

2 gallons to brush your teeth

2 gallons to wash your hands

5 to 10 gallons for every minute you water your lawn or garden

36 gallons to take a bath

25 to 50 gallons to take a shower

20 gallons to wash dishes by hand

10 gallons to use an automatic dishwasher

Handout 2D

THE WATER CYCLE

Did you ever wonder where water comes from, where it goes, and how it gets there? In nature, water circulates endlessly through a system called the water cycle. This cycle begins when heat from the sun causes water to evaporate. This water comes from the land, lakes, rivers and especially the oceans. The sun-warmed water vapors rise into the atmosphere where the vapor slowly cools and **condenses** into water drops that form clouds. Plants are also a part of the water cycle. After plants have taken water from the ground through their roots, it is passed through their leaves by a system called **transpiration**. Eventually the moisture returns to earth as **precipitation**. The water changes its form from liquid, to gas, to solid, and its location from the ocean, to the air, to the land, and back again.

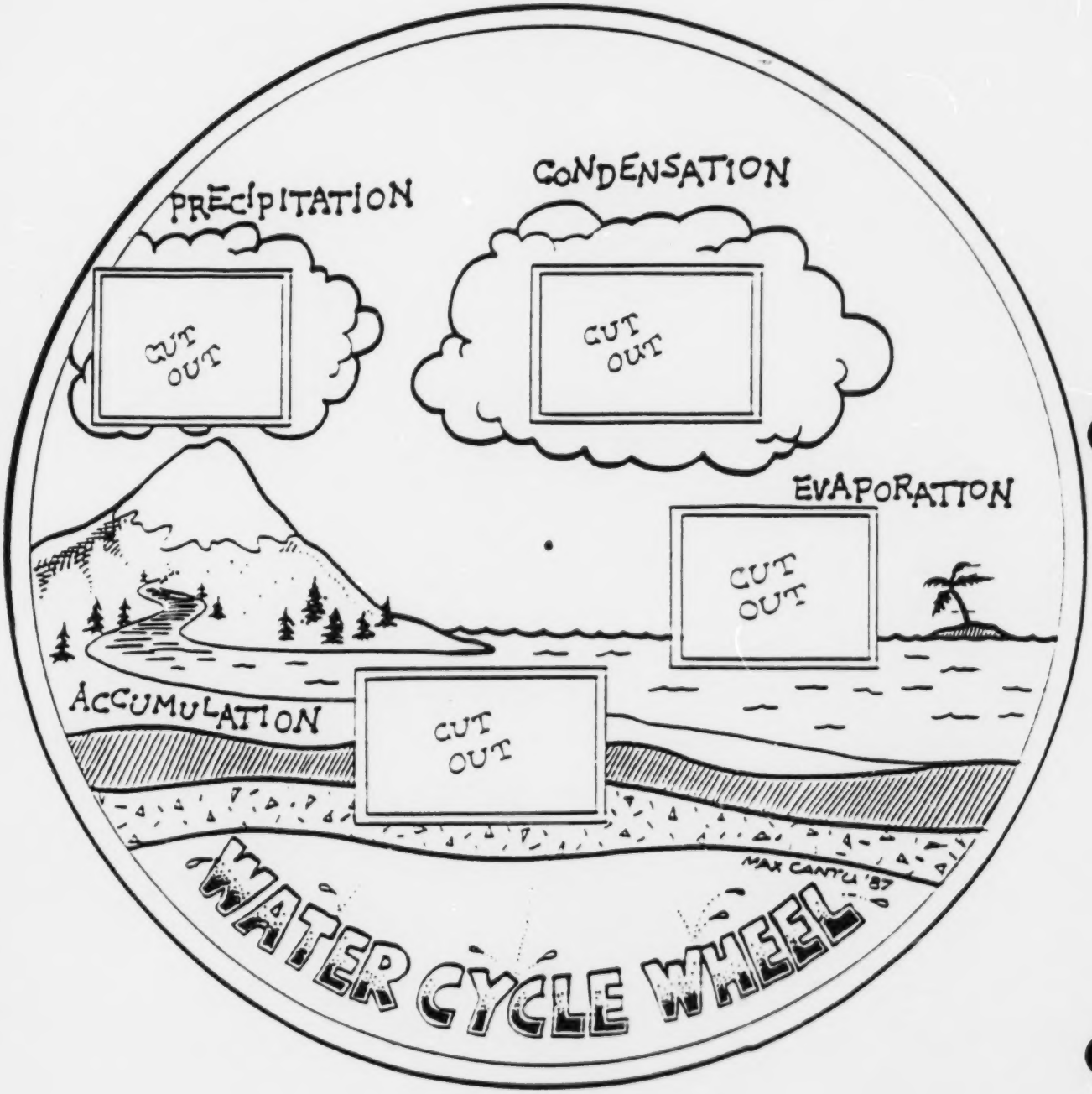
When it rains or snows, most of this precipitation becomes either groundwater or surface water. Some of the moisture that falls on the land evaporates, some runs off into streams and what is left soaks down into the soil. Water in the soil not used by plants is collected in the spaces between soil particles and fills the cracks and fractures in underground rocks. The special rock formations that hold and transmit water are called aquifers from two Latin words: *aqua* which means "water" and *ferre*, meaning "to carry." The water in aquifers is referred to as groundwater, and the top of the groundwater level is the water table.

Moving Raindrops

The water cycle model on the following two pages, "Moving Raindrops," can be duplicated for use by the students. Color the pictures on the two pages and then cut out the two large circles. Cut out the four rectangles that are indicated on circle one. Attach the two circles together (one on top of the other) with a metal fastener through a hole in the center. Using the tab on circle two, move the circle counterclockwise and watch the water cycle at work!

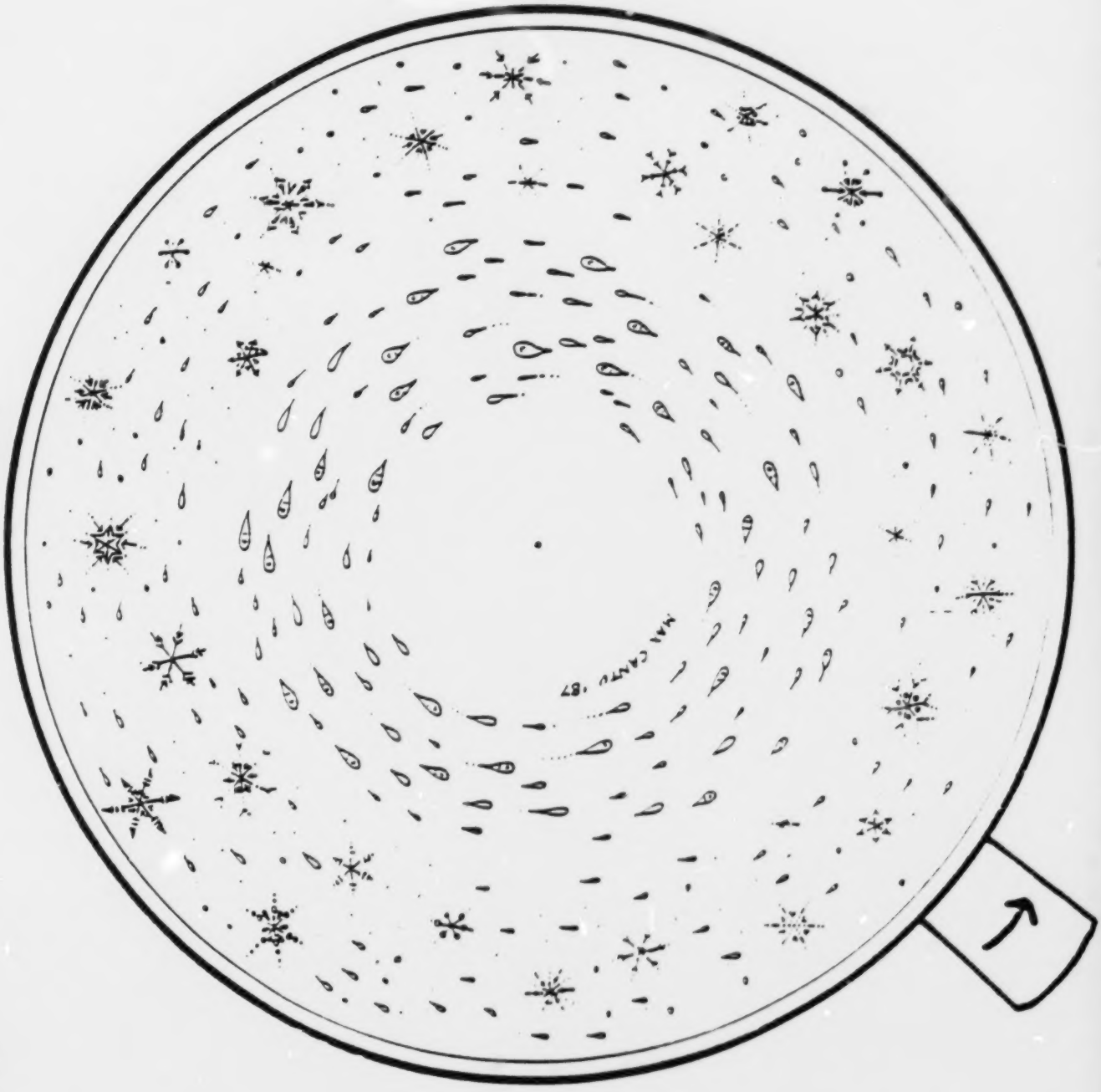
Handout 2D

Moving Raindrops



Handout 2D

Moving Raindrops



The Land We Depend On

Soil. Dirt. Land. No matter what you call it, it's the material that makes up the top layer of the earth. We build our homes on it. We raise food in it. We mine resources such as coal from beneath it. We bury our garbage within it.

Soil appears to be unchanging and lifeless, but soils are really full of life and always changing. One teaspoon of soil can contain billions of organisms ranging from simple bacteria and fungi to more advanced forms of life such as earthworms, insects, and spiders. New soil is always being created by rock that is continually broken into smaller particles and worn down by the pounding of water and wind, but the process occurs so slowly that we usually never notice.

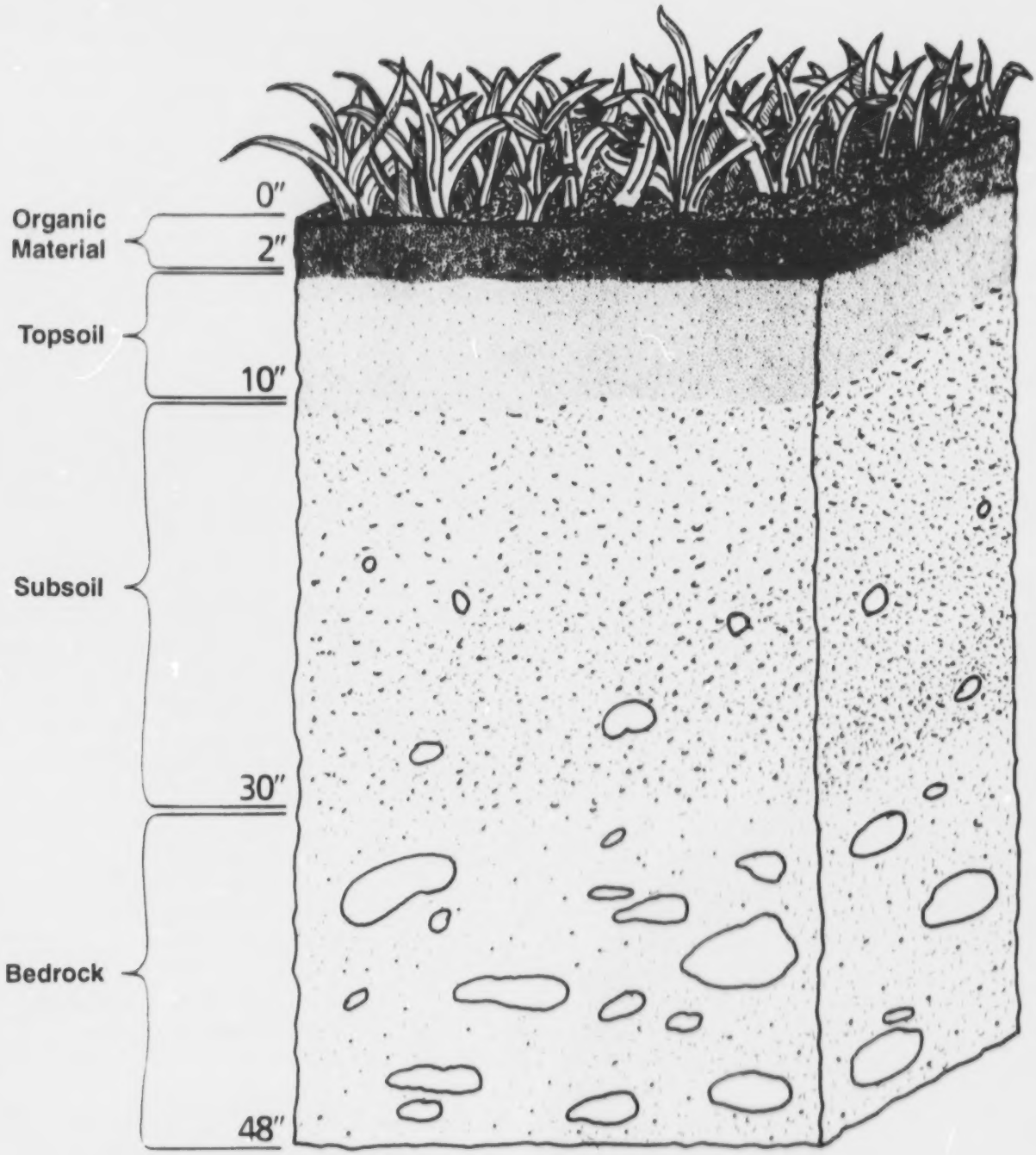
Soil is a mixture of minerals (clay, silt, sand, gravel), water, air and organic matter or humus (both living organisms and dead plant and animal material). The particles of minerals in the soil give it texture and color. Soil made up of sand has large particles, feels gritty, and is pale brown to yellow; silt particles are smaller than sand, feel like flour and are black, dark gray or dark brown; and clay is brown to yellow brown or red and feels sticky when it is wet. There is water and air in the small spaces between the particles of soil. This is important so that organisms can live in the soil. The organic matter (living and/or dead plants and animals) has an important role to play in the soil. They help recycle **nutrients** and make the soil rich and fertile (*See Handout 2E, A Soil Profile*). There are thousands of different types of soils throughout the world. Some are quite rich, such as the soil in Illinois, and other soil is weak and poor.

We depend on and use the land. Vegetables, flowers and trees are grown in the soil. Animals are raised on grasses, grains and soybeans that are grown in soil. Resources such as coal, iron ore, and petroleum are mined from beneath the soil. We build our homes, businesses, roads and cities on the land.

The quality of the land can be damaged by human actions. Land pollution usually occurs because people do not understand soils and then poor decisions are made as how to use the land. Land pollution can occur in both rural and urban areas. Land can be polluted through agriculture. A plowed field without plant cover will lose valuable **topsoil** through water and wind **erosion**. The plants are needed to hold the soil. Certain agricultural chemicals, like pesticides, can also build up in the soil and pollute the land. In urban areas, trees and other plants are often removed from construction sites and then the soil erodes. Large landfills are dug in the soil to dispose of our garbage, and storage tanks for gasoline are placed underground. If landfills and tanks are not constructed properly, their contents can leak into and pollute the soil. Hazardous materials such as pesticides, herbicides, household cleaners, paint removers, metals and petroleum products present a special challenge. Many precautions must be taken when handling these materials and when disposing of them in a **hazardous waste** landfill or other form of disposal, so as to prevent pollution.

Handout 2E

A Soil Profile



Air, Water and Land Quality in Illinois

I. Air Quality in Illinois

The Illinois Environmental Protection Agency monitors (tests) the level of six pollutants in the air throughout Illinois. These six pollutants include ozone, particulate matter, carbon monoxide, nitrogen dioxide, sulfur dioxide, and lead. Each of these pollutants has a safe level that can be in the air. If an air quality monitor (a machine that is used to take a sample of air and test it for certain pollutants) indicates that a pollutant is above that level for more than one hour, it is called an **exceedance**.

Most of Illinois has good air quality. However, the Chicago area is ranked in the top nine worst areas in the United States for the pollutant, ozone (ozone at the ground level, not in the atmosphere). Also, the East St. Louis area, while it is not as bad as Chicago, has high levels of ozone. In 1992, there were three days when the air was unhealthy in the Chicago area due to ozone.

Particulate matter (small solid particles, such as soot and dust, and liquid droplets) is an air pollutant that did not have any exceedances in Illinois in 1992. The amount of particulate matter in the air in 1992 was about the same as in 1991, and was less than in 1990. Particulates are produced by several sources including power plants, wood burning stoves, leaf burning, automobile exhausts, incinerators, rock quarries, coal processing plants, farming and roadways. Particulate matter can bother people with respiratory diseases such as asthma, and may irritate your eyes.

Carbon monoxide caused one day of unhealthy air quality in 1992. The amount of carbon monoxide in the air now is less than in the year 1990. Carbon monoxide is a colorless, odorless, poisonous gas formed from the incomplete burning of fossil fuels such as coal, oil and gas. Carbon monoxide is produced by power plants and automobiles. When a person inhales carbon monoxide, the supply of oxygen to various body organs is reduced and can cause visual impairment and headaches. Exposure to large amounts of carbon monoxide can also stress the heart, affect the brain, and even cause death.

There were no exceedances for nitrogen dioxide in Illinois in 1992. In fact, nitrogen dioxide has not caused unhealthy air quality in Illinois since 1980. Nitrogen dioxide is released into the air from burning fossil fuels at high temperatures. Some nitrogen dioxide occurs naturally in the soil and atmosphere. High levels of nitrogen dioxide can strain the heart and respiratory system and increase the chances for breathing problems and illness.

There were also no exceedances in 1992 for sulfur dioxide. Sulfur dioxide is a colorless gas formed when fossil fuels and other substances that contain sulfur are burned. Major sources of sulfur dioxide emissions are factories and power plants where coal and other fossil fuels are burned. Many people experience eye, nose and lung problems when they are exposed to high sulfur dioxide levels.

Perhaps the greatest success story in controlling air pollution concerns lead. Since a law was passed in 1975 that required cars and trucks to use only unleaded fuel, the amount of lead in the air has decreased by 85 percent. In Illinois, there were unhealthy levels of lead in the air for only two days in 1992. Lead is classified as a heavy metal. Very small particles of lead can be found in the air we breathe, in the water we drink, in the food we eat, and in some soils. Once taken into the body, it tends to remain there. Lead in the air comes primarily from the burning of leaded gasoline, iron smelters (places where ore is melted to separate metals) and battery manufacturing plants. Health effects related to lead poisoning (especially in young children) include brain damage, muscle cramping, and **anemia**.

Overall, the quality of air in Illinois is improving each year. The IEPA continues to work to change and improve the methods of testing and controlling air pollution in Illinois, so that the air we breathe is clean.

II. Water Quality in Illinois

Illinois is rich in surface water resources with approximately 900 rivers and streams for an estimated total of 35,350 stream miles and 85,305 lakes and ponds. The state is bordered by three major rivers, the Mississippi to the west, and the Ohio and Wabash to the southeast. The other large rivers in Illinois include the Rock, Fox, Des Plaines, Kankakee, Illinois, Sangamon, Kaskaskia and Big Muddy.

Nearly one million acres of Lake Michigan stretch along Illinois' northeastern border. Lake Michigan is the third largest of the Great Lakes and is the largest body of freshwater entirely within the United States (portions of Lake Superior and Lake Huron are in Canada).

The majority of Illinois' lakes are manmade. Illinois lakes serve many purposes such as for drinking water, fishing, boating, flood control, industrial plant cooling water, and fish and wildlife habitat.

River and stream water quality in Illinois has improved considerably since 1972. (In 1972, the Clean Water Act was passed to protect the water in the United States.) The number of rivers and streams with poor water quality has declined, while the number of rivers and streams with good water quality has increased. Water is tested at more than 1,500 **monitoring** stations throughout Illinois to determine water quality conditions. Agricultural activities contribute the most pollution to Illinois rivers and streams. Soil erosion, livestock waste, fertilizers and pesticides are the most common agricultural pollutants. The other major sources that pollute Illinois rivers and streams are point sources (pollution that comes from a pipe such as from a factory or wastewater treatment plant), habitat change (removing plants such as trees from stream banks or changing the course of a river or stream), urban runoff (oil, chemicals, soil and other pollutants that are washed from streets, parking lots and driveways) and resource extraction (removing resources from the land, such as coal).

Portions of the Des Plaines, Sangamon and Mississippi rivers contain fish with high levels of toxics. Fish consumption advisories have been issued for parts of these rivers. A fish consumption advisory identifies species of fish within certain bodies of water that contain enough **contaminants** that the public should limit the amounts they eat, or in some cases, not eat them at all.

In general, the quality of water in the majority of lakes in Illinois is declining. This is not surprising since lakes function as traps or sinks for pollutants from **watersheds**. Like rivers and streams, lakes are mostly polluted by agricultural activities. Pollutants such as **sediment** and nutrients wash into lakes. The water in polluted lakes may have bad taste and odor, be overgrown with aquatic plants and/or look dark brown or green. The water quality problems in lakes limit the use of the lake for fishing, boating, and swimming, affect the aquatic life and shorten the life span of the lake (because the lake is filling in with sediment). A few Illinois lakes have improved in quality. Those lakes

showing improvement are part of special restoration projects to reduce the amount of pollution that reaches lakes.

The IEPA tests for toxic pollutants in the fish and sediments of lakes. Some fish should not be eaten or eaten only occasionally in the following 12 Illinois lakes: Michigan, Springfield, Decatur, Taylorville, Bracken, Vermilion, Lou Yeager, Clinton, Dresden, Kincaid, Cedar, and Crab Orchard lakes.

The IEPA and the city of Chicago monitor (test) Lake Michigan's water quality. Information from Lake Michigan water testing has shown that the water quality of Illinois' portion of Lake Michigan has improved over the last 20 years. For example, the amount of pollutants such as **phosphates** and **ammonia** has declined. Phosphates and ammonia are found in sewage, industrial waste, and runoff from agricultural fields. In general, Lake Michigan water quality conditions are very good.

Lake Michigan includes a total of 63 shoreline miles, forming the northeastern portion of Illinois' border. The lake provides drinking water for the city of Chicago, as well as many of its suburbs. Sixty-two miles of Illinois shoreline support swimming. Some species of fish within Lake Michigan should not be eaten.

There are toxics which are often found attached to sediments within several Illinois harbors on Lake Michigan. These sediments include such toxics as **polychlorinated biphenyls (PCBs)**, **copper**, lead and **zinc**. For example, sediments within Waukegan Harbor have been found to be contaminated with PCBs. As a result, a cleanup project was done to remove these pollutants. Toxics such as PCBs are also found in Lake Michigan fish. These toxics **bioaccumulate** in fish, which means that older and larger fish tend to have higher levels of pollutants.

In Illinois, more than five million people rely on groundwater for drinking water. This is nearly 50 percent of the state's population. Approximately 74 percent of the communities in the state use groundwater for drinking water, and industry consumes more than 24 percent of the total groundwater used in Illinois each year. The overall quality of the state's groundwater is good.

The IEPA tests the water of more than 3,300 community water supply wells. The IEPA does not **regulate** or test private wells. This is handled by the Illinois Department of Public Health. Of the community wells tested, 5 percent have chemical pollutants within the water. Seven hundred eighteen (718) community wells have been tested for pesticides, and in 2 percent of those wells (14 wells) one or more pesticides were found in the groundwater. The major sources of groundwater pollution in Illinois are storage and disposal facilities for hazardous waste, surface and underground petroleum storage tanks, landfills, **septic tanks** and agricultural chemical operations.

III. Land Quality in Illinois

Illinois contains 55,646 square miles (or 36 million acres) within its boundaries. This includes land and water surface areas. There are currently 32 million acres of rural land. In 1991, 22 million of the rural acres were harvested for agricultural purposes. Of the rural land in the state, more than three million acres are forested. Urban areas and transportation routes (highways and railroads) cover almost three million acres of Illinois. The remainder of the land in Illinois is federal land or surface water.

One of the biggest problems in rural areas is erosion of soil. About 35 percent, or roughly 11 million acres of rural land, needs some form of treatment to control soil erosion caused by water and wind. Overall, Illinois is losing approximately 201 million tons of soil each year due to erosion. The goal in Illinois is to reduce the amount of soil that is lost to 66 million tons per year by the year 2000.

The land quality in Illinois can be affected by many things. Our "throw-away society" discards millions of tons of solid waste or garbage daily *(See Handout 2F, What's In Our Garbage?)*. Every man, woman and child in Illinois generates from four to seven pounds of solid waste each day. Homes, industry, businesses, government and school institutions all contribute to this growing waste problem.

The disposal of these wastes is a serious problem throughout the country. In our state, one to two million tons of hazardous waste are generated annually. These hazardous wastes present a special challenge, in comparison to garbage. In addition, cleanups are needed at thousands of sites contaminated with petroleum products (gas, oil, etc.) to protect the environment and the public's health.

There are about 1,600 properties in Illinois that could be contaminated by hazardous waste. This does not include more than 10,000 reported incidents from leaking underground storage tanks or accidental spills and releases that call for emergency responses or cleanups by the IEPA and other government agencies.

Before 1970, pollution control efforts were directed only toward the most extreme violations of the state's public health laws. Since its establishment, the IEPA has made excellent progress in closing open dumps (not the same as legal landfills) and managing solid and hazardous waste.

With stronger landfill regulations, the number of solid waste landfills in Illinois has declined from 146 in 1987, to 106 in 1992. It is estimated that by the year 2000, if we continue to throw away our waste at current rates, only 35 landfills will remain in operation if no new facilities are built. This will result in fewer, larger landfills to handle the disposal of waste.

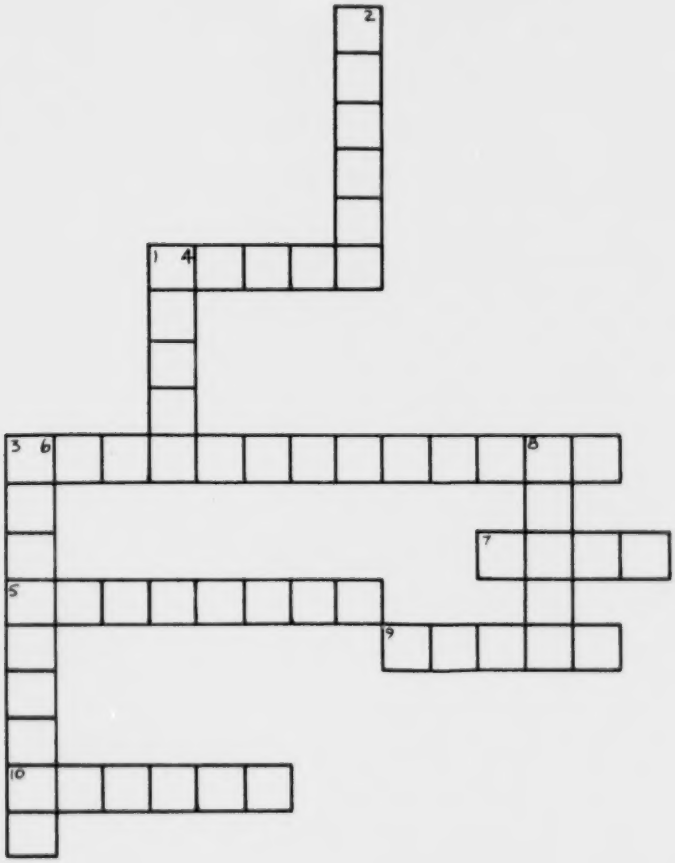
How we manage the waste we generate has a direct effect on our quality of life and the land we depend on.

Handout 2F

What's in Our Garbage?
37% paper and paperboard
18% yard wastes
10% glass
10% metals
8% food wastes
7% plastics
5% rubber, leather and textiles
5% wood and other

Worksheet

"Crossword Puzzle"



ACROSS

1. living things which help clean the air.
3. rain, snow, sleet.
5. where people dispose of garbage and other waste.
7. rich and fertile material that contains minerals, water, air, and organic matter.
9. most common substance on earth, can be a liquid, solid, or gas.
10. colorless, odorless gas in the air that is necessary for life.

DOWN

2. the Mississippi and Illinois are examples of this type of water body.
4. poisonous, harmful, deadly.
6. contamination of air, water, and land.
8. a major air pollutant in the Chicago and E. St. Louis areas.

3

Environmental Issues

We now realize that we are not apart from, but a part of, the environment. This new understanding has created awareness of more and more environmental issues. Environmental issues can be complex and controversial, involving many conflicting points of view. Sometimes these points of view are based on scientific knowledge and sometimes on values or opinions. There are no absolute rights or wrongs, nor are there any single answers to the problems. Decisions made about environmental issues are often compromises made by people and groups. The purpose of this chapter is to introduce students to some environmental issues within Illinois.

The Treatment of Drinking Water

A Glass of Cold, Sparkling Water

Safe drinking water is something many people take for granted. It's easy to see why. What could be more simple than turning on the tap and getting a drink of water? But behind each gallon, behind each drop, are the efforts of scientists, engineers, legislators, water plant operators and regulatory officials. It is their job to keep the water clear, clean and safe.

Our drinking water supply comes from two sources--groundwater and surface water. Groundwater comes from the reserves of water hidden beneath the earth in aquifers. Surface water is the water in rivers, streams and lakes.

Where Does Our Drinking Water Come From?

At first, many early settlements were near surface water sources. However, these communities became crowded and people were forced to move farther away from the rivers and lakes.

The people who lived some distance from lakes and rivers also needed a good, clean and easily available supply of water. To get a steady supply of water, people dug wells. For hundreds of years, people had to dig wells by hand. Today, most people don't dig wells by hand. Instead, they use powerful drills to dig wells. Most people who live in the country get their water from wells.

What Happens to Water Before It Comes Out of the Faucet?

About 1,900 public water supply systems deliver more than 1.77 billion gallons of safe, clean drinking water to Illinois water consumers each day. The majority of public water supplies pump water from wells for treatment and distribution to consumers. The largest percentage of the population drink surface water, because large numbers of people living in Chicago and the areas around it use treated water from Lake Michigan.

Thousands of workers at modern water treatment plants maintain the quality of our drinking water supply. The drinking water treatment process can be broken down into seven steps. Here is how a water treatment plant works *(See Handout 3A, The Drinking Water Process)*:

INTAKE: Water from a surface source, like a lake or a river, is drawn into a treatment plant. Intake screens strain out large debris such as fish, sticks and plants. If the source is groundwater, the screening process is done by nature because the water is cleaned by travelling through layers of sand and rock.

PRE-TREATMENT: Chemicals such as **chlorine**, **alum** and lime are added to the water to remove impurities, soften the water and destroy bad tastes, colors and odors. Excess lime can also be added to remove from the water minerals which leave deposits called "scale."

MIXING: The water is next stirred by mechanical mixers, to blend the chemicals through the water.

COAGULATION & FLOCCULATION: The water then travels to a large basin. Some of the chemicals cling to the impurities in the water (**coagulation**), forming large, heavy particles. These particles are called **floc**. these particles become heavy and settle to the bottom of the sedimentation tank.

FILTRATION: From the sedimentation basin, where most of the floc has settled to the bottom, the water travels through sand beds which filter the water to remove any impurities which are left.

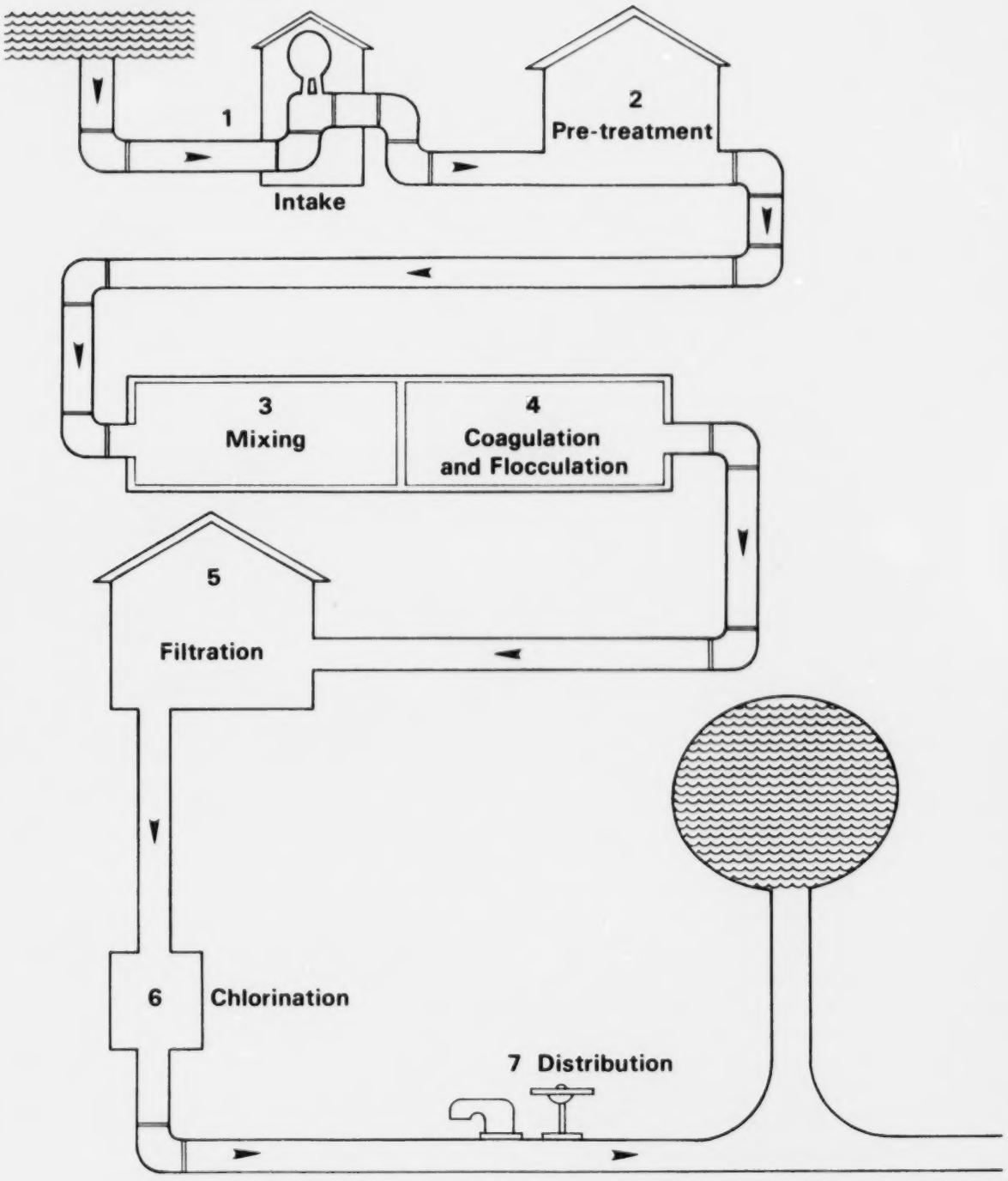
CHLORINATION: Chlorine is added to kill bacteria and keep more bacteria from growing as the water travels to the consumer. Most water treatment plants also add fluoride at this point.

DISTRIBUTION: After the water is clean, it is stored in elevated tanks, stand pipes, or covered **reservoirs**. The water then travels through large pipes called "mains" to houses, schools and businesses.

(Reprinted from The Story of Drinking Water, by permission.
Copyright 1984, American Water Works Association.)

See also "Sink to Stream" poster.

Handout 3A



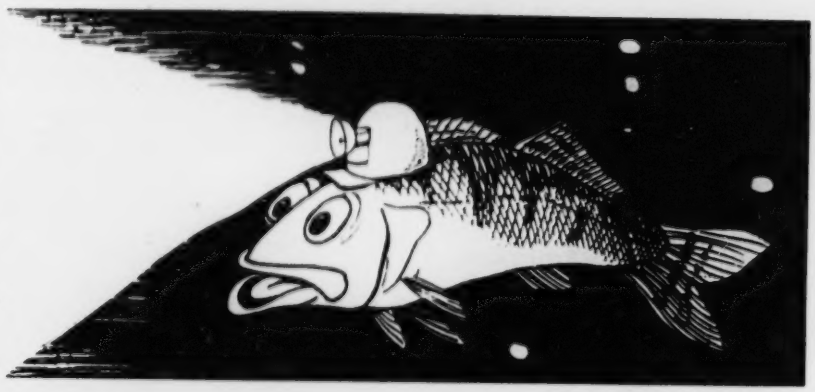
The Drinking Water Treatment Process

Nonpoint Source Pollution

When water from melting snow or rainfall flows across farm fields and city streets, it washes soil particles, pesticides, pet wastes, oil and toxic materials into lakes, streams, and groundwater and becomes nonpoint source (NPS) pollution. Another word for NPS pollution is polluted **runoff**. Nonpoint source pollution is not a familiar word to most of us. The symptoms, however, are familiar: green, weed-choked lakes, muddy rivers, and eroding banks of rivers and lakes. In Illinois, some 55 percent of the streams have been affected by NPS pollution, and the majority of Illinois lakes (91%) have suffered from NPS pollution. Most NPS pollution is caused by the runoff of sediments and nutrients into the water. As you will see, these pollutants can cause serious problems.

SEDIMENTS- Sediments are soil particles that erode from cropland, construction sites, and stream banks. Sediments also include flakes of metal and broken pavement that wash off city streets. When these particles reach lakes and streams they do more than turn the water brown.

Sediments cause the water to become cloudy, making it difficult for fish to see and feed properly. Sediments also can damage fish gills and the feeding and breathing of aquatic insects.



Many fish and aquatic insects lay their eggs on the gravel stream bottom. When sediments flow into the water and build up on the stream bottom, they cover this **spawning** habitat. They also destroy a stream's natural riffle and pool pattern. Riffles are rapidly flowing areas of a stream where the surface of the water is broken by rocks or other objects in the stream, and pools are deeper areas in a stream where there is little or no current. The destruction of riffles and pools produce a muddy, slow-moving stream that is not attractive.

Muddy water contains millions of soil particles. In moving water, these particles can act like a scouring pad and remove aquatic plants and animals from their **habitat.**

Sediment runoff cause streams to become shallower and wider, which causes flooding problems. The shallow water is also heated more by the sun. This causes water temperatures to rise and in time, cold water fish such as trout cannot survive, and only warm water fish, such as carp, are found.

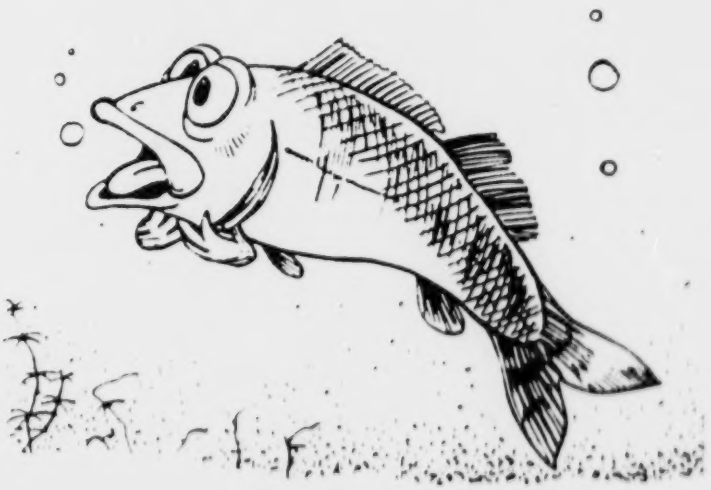
Sediments increase the chances of boats getting stuck in the mud of a lake or river. Swimmers also can get stuck in the mud. Muddy swimming areas can be ugly and dangerous.

Sediments cloud the water and cover plant leaves. This reduces the amount of sunlight that reaches into the water, and this affects photosynthesis. Without photosynthesis, plants cannot survive, and this leaves no place for fish and small organisms to live or find food to eat.

Sediments harm duck and geese populations by filling in wetland areas that are used for breeding.

Sediments can carry toxic materials that can contaminate small organisms. When fish and waterfowl eat these small organisms, the toxics build up in their bodies and can cause illnesses, birth defects and even death.

NUTRIENTS- Nutrients come from sediments, manure (even pet wastes), and fertilizers used on lawns or farm fields. When these nutrients reach our lakes and streams, they do more than turn the water green with weeds and **algae**.



Nutrients can cause the over-fertilization of lakes. This leads to an increase in weed and algae growth. Plants are needed in water but too many weeds and algae are harmful to fish and make a lake less attractive for swimming, boating, and other activities.

When algae and aquatic weeds die they are broken down through **decomposition** by bacteria. Bacteria take in oxygen during decomposition which removes oxygen from the water. This makes it difficult for fish and other aquatic life to survive.

Excess algae can reduce the amount of bottom-rooted plants by blocking sunlight. Bottom-rooted plants provide food and habitat for fish and waterfowl.

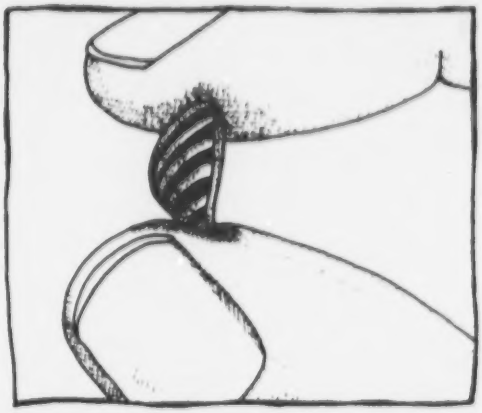
When materials such as manure, leaves, and grass clippings enter a lake or stream, they are broken down by bacteria. The decomposition of these materials reduces the amount of oxygen in the water and may release a gas called ammonia. Low oxygen levels and ammonia combined with warm water temperatures can kill fish.

We don't have to settle for streams and lakes that are brown with sediment or green with algae! The IEPA helps groups to improve water quality. Through the Clean Water Act, the IEPA is able to give grants (money) to groups for projects that control nonpoint source pollution. The grants are used for such things as controlling erosion from farm fields and construction sites, protecting wetlands, and protecting and restoring streambanks. If your

favorite lake or stream is not as clean and beautiful as it once was, maybe it is suffering from nonpoint source pollution.

Zebra Mussel Alert!

What is a zebra mussel? The zebra mussel is a bottom-dwelling clam that is native to Europe. Compared to common clams, zebra mussels are very small. A large zebra mussel will only be about two inches in length; most will only be about the size of your fingernail. Its name comes from the striped pattern on its shell. The mussels can live up to five years and will attach to almost any hard surface. Zebra mussels now inhabit all the Great Lakes and have spread rapidly into major rivers in Illinois. They are now found in the Chicago waterways and throughout the Illinois, Mississippi and Ohio rivers.



The zebra mussel is considered a threat to the waters of Illinois. Zebra mussels **colonize** on almost any hard surface including the water intake pipes for industrial plants and water plants. Zebra mussels colonize one on top of the other, forming large masses that can clog pipes. A single female can produce more than 40,000 mussels a year. These mussels can damage the aquatic food chain, as they filter one to two liters of water each day, taking in large amounts of tiny aquatic plants and animals. Fish spawning habitat can be damaged as the zebra mussels colonies cover these rocky bottom areas, which can reduce populations of some species of fish. Beaches can be affected by the large number of mussel shells washed to shore after storms. As you can see, zebra mussels are a serious threat to public water supplies, industry, lake and rivers, and recreational activities such as fishing, swimming and boating.

In June 1988 the first zebra mussel was discovered in North America. They were discovered in Lake St. Clair in Michigan. Since that time, they have spread rapidly. Zebra mussels spread both naturally and by human actions. Mussels are naturally spread by waterfowl (ducks and geese), crayfish and turtles. Zebra mussels can attach to boat motors, **hulls** and trailers and may survive a week or more out of the water. Mussels can be drawn into the engines of boats where they can quickly reproduce and clog the engine system. Zebra mussels also can be transported in bait buckets and trash.

In order to slow the spread of zebra mussels, boats and trailers should be routinely checked and cleaned. If you find any zebra mussels, they should be disposed of in the trash. If you know that a certain river or lake contains zebra mussels, you should not transport bait fish or water from that site, or

Worksheet

Zebra Mussels

Why are biologists concerned about the invasion of zebra mussels?

Where large populations of zebra mussels become established they can impact fish spawning habitat and possibly decrease the numbers of some fish. They may also threaten a variety of water users. Fill in the numbered spaces with the correct letter to discover the Illinois water users that could be affected by these exotic invertebrates.

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26

1. _ _ _ _ _ _ _
   2 15 1 20 5 18 19

2. _ _ _ _ _ _ _ _
   19 23 9 13 13 5 18 19

3. _ _ _ _ _ _ _
   1 14 7 12 5 18 19

4. _ _ _ _ _ _ _ _ _ _
   9 14 4 21 19 20 18 9 5 19

5. _
   12 15 3 1 12 23 1 20 5 18 19 21 16 16 12 9 5 18 19

6. _
   3 21 12 20 21 18 5 4 16 5 1 18 12 9 14 4 21 19 20 18 25

7. _ _ _ _ _ _ _ _ _ _ _ _ _ _
   14 1 20 9 22 5 13 21 19 19 5 12 19

the zebra mussel **larvae** in that water could attach to another site and colonize in that water as well. Remember, it only takes one adult female and male zebra mussel to start a new colony!

As a result of the ever-growing zebra mussel problem, the IEPA samples for zebra mussels in 22 Illinois lakes. No zebra mussels were detected in the lakes during 1992. This is good news! In the future, more lakes and rivers in Illinois will be tested for zebra mussels, and the IEPA will work with the public to control and monitor the spread of this invader.

Wetlands

Wetlands are just what the word says, "wet lands". Wetlands are either covered with shallow water or have soils **saturated** with water for periods of time during the growing season. They vary in size, shape, and type because of climate, vegetation, soils and water conditions. There are many types of wetlands such as **freshwater marshes**, **prairie potholes**, **swamps**, and **bogs**.

Wetlands are found in every state in the nation. However, more than half of America's wetlands have been drained, filled, or destroyed. Illinois has lost almost 90 percent of its wetlands. There are an estimated 920,000 acres of original wetlands remaining in the state, and Illinois loses between 4,000 and 6,000 acres of wetlands each year.

Wetlands are important for many reasons. Wetlands are habitat for many types of fish, birds, turtles, frogs, snakes, insects and plants. Wetlands are very complex **ecosystems** because of all the organisms they contain.

Wetlands are also important in controlling the flooding of rivers and streams. Wetlands store flood water that overflows stream banks and surface water that collects in low areas.

One of the most important functions of wetlands is to help improve the water quality in our lakes, rivers, streams, and groundwater. Wetlands clean polluted water by acting as a filter, allowing sediments, nutrients and pesticides to settle out of the water and trapping these pollutants. This is possible because of the slow moving water in the wetlands.

Finally, wetlands are great places for activities such as fishing, canoeing, hiking and bird-watching. They also provide an excellent place to see **threatened** or **endangered species** such as the bald eagle and whooping crane. Wetlands provide open space and beauty for urban and rural areas.

Because of these reasons, wetlands are very important, not only to humans, but to many other organisms. However, wetlands continue to be threatened by agriculture, urban development and water pollution.

Agriculture can be a problem when farmers drain wetland areas to plant crops. Developers drain wetlands and fill them to create new places for houses or office buildings. Pollution from industries, agriculture and urban areas is another threat, because it can contaminate the water and damage or kill the plants and animals that live in the wetlands.

Get to know a wetland and experience the thrill of hundreds of geese in flight, the sounds of frogs on a summer evening, or the beauty and color of wetland plants. You can help protect wetlands by simply learning and caring about them.

How Do Wetlands Change as a Result of Human Activity?

A. Change can happen quickly to wetlands as when a bulldozer fills in a wetland during the construction of a home or highway.

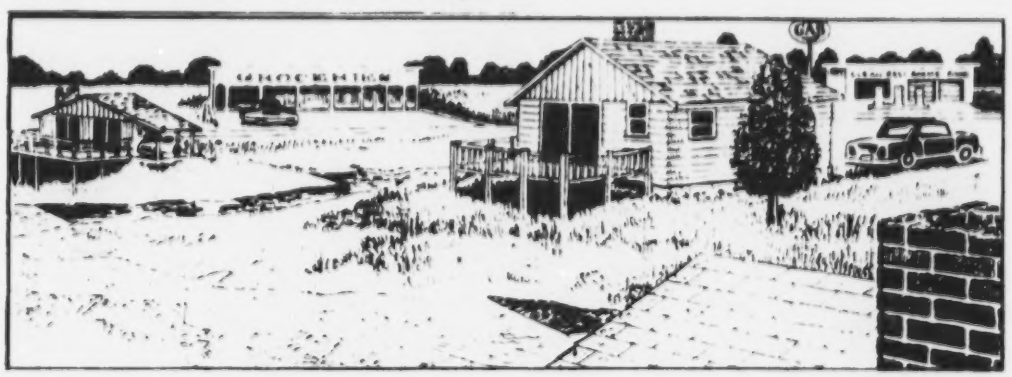
B. Land use changes nearby such as new roads or lands that are drained for agricultural fields may increase polluted runoff into the wetland, gradually changing both the water quality and the amount of sediment which enters the wetland.

C. New land uses will cause additional changes in the habitat because there is less of a buffer for the wetland. A buffer is a strip of land for protection between wetlands and developed land (such as for towns, businesses,and farm fields). As homes and businesses are placed closer and closer to the wetland, animals that are less tolerant to human disturbance will not be able to raise their young and will eventually leave the area. The plants of the wetland also will change as some species that can not **adapt** will die out and are

replaced by other species which are more tolerant to pollution, many which are not **native** to Illinois.

D. Developed areas move ever closer to the wetland as there is an increasing demand for land. As this occurs, there is a lower **diversity** of plant and animal species. As runoff increases, it carries eroded soil from the agricultural fields which gradually fills in the deep areas of the wetland.

E. Eventually the wetland is so surrounded by development that it can no longer survive. Although is was not paved over, it has been destroyed because it no longer supports the plant and animal life it once had or help with flood control for the surrounding land.

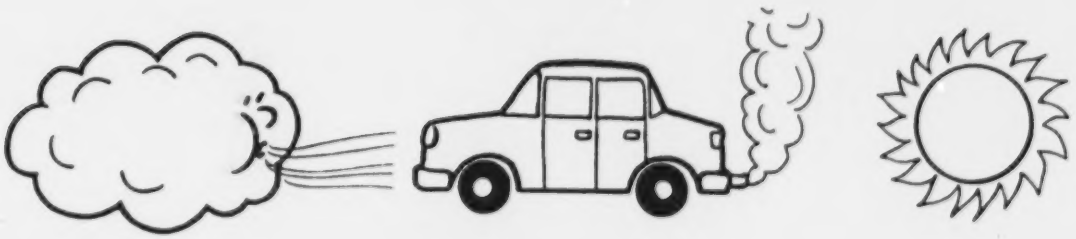


OZONE - Is it Good or Bad?

The word, ozone, can be very difficult to understand because it has more than one meaning. So, what is ozone, and is it good or bad?

If ozone appears in the lower atmosphere where we live and breathe, it is bad. It is a toxic gas that is often called smog. The ozone that exists in a layer way up in the **stratosphere**, 10 miles above the earth's surface, is good. It protects the earth by blocking dangerous ultraviolet (UV) rays from the sun.

Bad ozone is created when fossil fuels such as coal, oil and gas are burned. The diagram below illustrates how the ozone is created:



AIR	+	**Hydrocarbons** from car and truck exhaust and factories that burn fossils fuels	+	SUN	=	Bad ozone/smog
Nitrogen, Oxygen						

This bad ozone can make the air look hazy and is especially strong on hot, sunny days with little wind. This ozone can hurt your eyes and throat. It is dangerous for babies and the elderly and people with heart and respiratory problems to be exposed to this ozone.

"Good" ozone is not made by people; it exists naturally high above the earth. The ozone layer is a shield that allows the sunlight to reach the earth, but filters out the UV rays. UV rays are dangerous to all living things. They can cause skin cancer in humans, destroy plants, and cause weather changes such as warmer temperatures. Some scientists are now very concerned about this special ozone layer because they believe it may be thinning or even disappearing. Holes in the ozone layer have been noticed over Antarctica, New Zealand, Australia and portions of South America. It is also believed that the ozone layer is thinning over the Arctic as well.

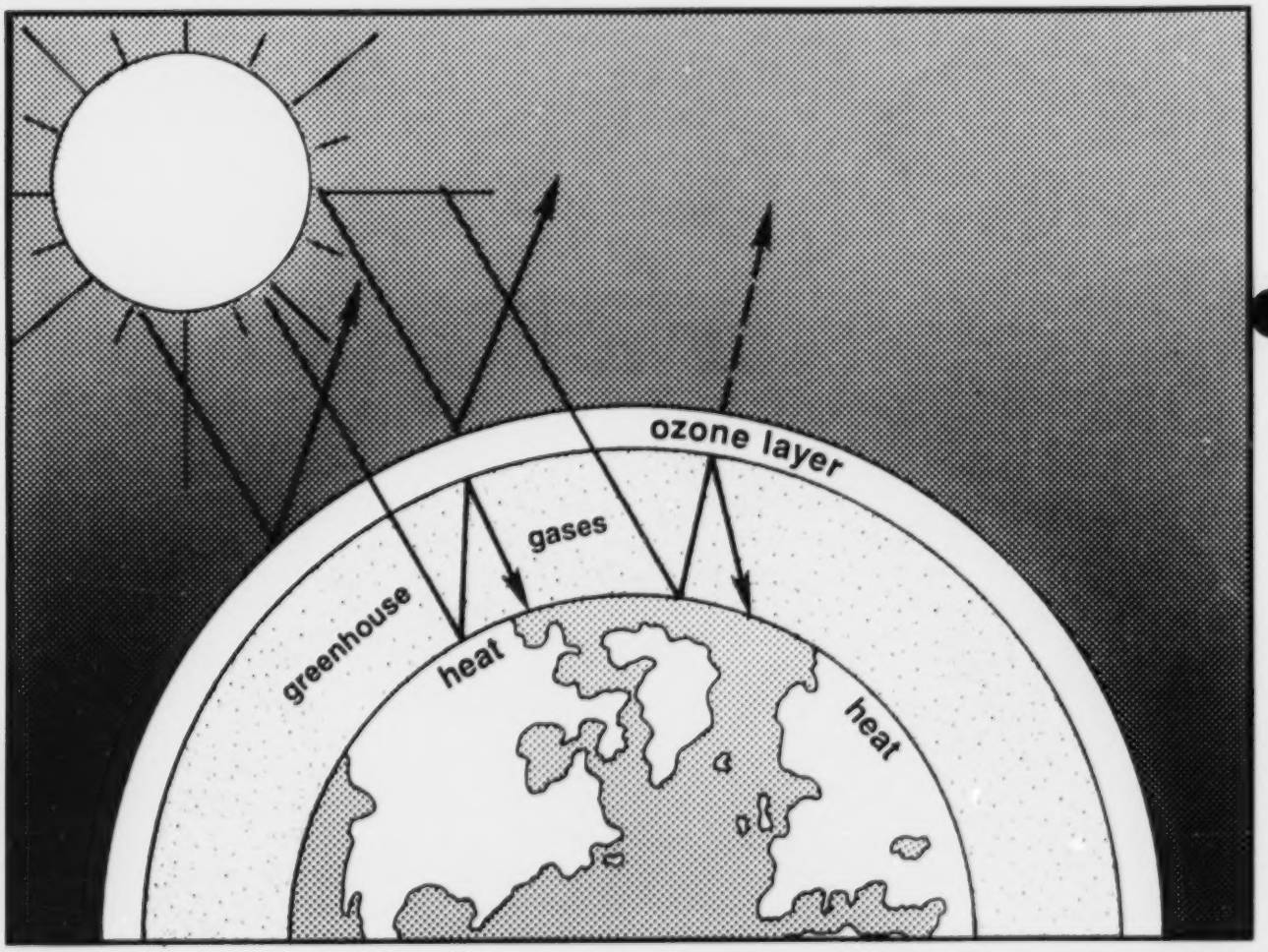
The ozone layer (good ozone) is possibly being damaged by man-made chemicals known as **chlorofluorocarbons**. Chlorofluorocarbon is a very difficult word to say and to remember, so it is shortened to **CFC**. When the CFCs drift up in the air to the ozone layer, the sun changes the CFCs from a safe chemical to a chemical that destroys ozone.

The problem with CFCs is that they are still found in some things that we use each day, such as some refrigerators and air conditioners of automobiles. As you can see, CFCs have been very valuable and helpful in our lives, but

now we also know that they can be harmful to the air we breathe. Scientists are trying to discover safer chemicals to use in place of CFCs.

Now you know that ozone is both good and bad. It depends on where the ozone is found. We couldn't live without the "good" ozone which makes up the ozone layer, and we wish we could get rid of the "bad" ozone or smog that we find in large cities such as Chicago.

The "Greenhouse Effect"



Global Warming

The temperature of the Earth is a balance between the amount of the sun's energy it absorbs and that which escapes (or radiates) back into space. Some natural and manmade substances, commonly known as greenhouse gases, allow the sun's energy to reach the earth's surface and block the escape of this heat. These gases form a blanket or "greenhouse" around the earth. The result of this is an increase in the earth's temperature. Without this greenhouse effect, the earth would not be suitable for life, because temperatures would be approximately 54 degrees Fahrenheit colder.

There is a great deal of concern that growing releases of greenhouse gases may cause global warming, because there is not enough energy being radiated back into space. Too many of these gases are being trapped close to the earth. Some scientists believe that temperatures may rise by 4 to 9 degrees Fahrenheit on the Earth by the next century.

Several gases in the atmosphere are considered to be greenhouse gases. Carbon dioxide is the most common greenhouse gas. The burning of fossil fuels (coal, oil, and gas) is the major source of an increase in carbon dioxide in the atmosphere. Fossil fuels are used in such things as electric power plants and automobiles. Carbon dioxide also enters the atmosphere through **deforestation**. Forests act as carbon sinks by absorbing carbon dioxide through photosynthesis. Destruction of forests not only removes these sinks, but when the trees are burned, it also releases what carbon dioxide the trees have stored.

Scientists are not sure what will happen if the earth continues to get warmer. It is believed that the faster the warming, the harder it will be to adapt. Some ecosystems and organisms may not adapt quickly. Populations could decrease in numbers and possibly face **extinction**.

Higher temperatures, if they occur, may lead to drier soils in many parts of the country. Some regions of the United States may have more or less rainfall. This could reduce both forests and yields of corn, wheat and soybeans.

Higher temperatures, if they happen, would most likely increase evaporation and may affect water quality. A rise in ocean level is one of the most certain results of global warming. Higher global temperatures will melt glaciers and polar ice caps and cause the water levels in the oceans to rise. This will destroy property along the coast and wetlands.

Is The Earth Really Getting Warmer?

The answer is- we really don't know. Some scientists argue that the earth's temperature has gone up and down for millions of years. Other scientists believe that we are now experiencing some of the warmest temperatures on earth since the age of the dinosaurs. We can only continue to study global warming and do what we can to reduce the build up of greenhouse gases in the atmosphere.

WASTE MANAGEMENT - A Problem for all of us

Garbage! It's a problem all right, but someone elses's - not mine. That's the reaction that most of us have. And yet, have you ever counted how many garbage bags and trash cans your family puts out on collection day or noticed how much trash you and your classmates throw away each week?

Food scraps, newspapers, candy wrappers, milk jugs, and cardboard boxes are among the hundreds of items you never expected to bother with again. Everyday in the United States the average person will throw away almost 7 pounds of garbage; 3 to 4 pounds of that garbage is just food waste. This adds up to two tons of food wastes generated by the average person by the time he/she is 18 years old, five tons by age 45, and eight tons in a lifetime.

Even more garbage or waste is generated each time we visit a restaurant, go to the ball park or visit the doctor. Factories that make the things we like to use like bicycles, toys, baseballs and computers add to the mountains of trash. We wouldn't have many of the things we buy or use without producing this garbage.

A Good Way to Get Rid of Trash and Garbage

Solid Waste

Solid waste is paper, food scraps, old stoves and other garbage that people throw away. Each year in the United States 132 million tons of solid waste is collected by garbage trucks. What should we do with it?

Litter

If we toss garbage away carelessly, it litters the roads, countryside, and waterways. Litter is land pollution. Not only is it ugly and a threat to wildlife, plants, and humans, litter also can be a breeding place for rats and insects.

Two percent of the country's solid waste ends up as litter. The only cause of litter is careless people. Tossing something out of a car window is a bad habit. Luckily, we can change our attitude and habits and stop littering. This will reduce the amount of garbage we see lying around.

Sanitary Landfills

If we dump trash in the open, it smells bad, looks ugly, and attracts rats and insects. **Open dumps** have been improved by turning them into sanitary landfills *(See Handout 3B, Layers of a Landfill and Handout 3C, Landfill Diagram).* Such landfills have been constructed to hold wastes and to keep them from contaminating surrounding water and soil.

A sanitary landfill is lined with clay, thick plastics, or both to prevent harmful liquids from leaking into the groundwater. This liquid, called leachate, is a mixture of rainwater and other liquids created by decomposing garbage. Leachate drains into collection pipes at the bottom of the landfill. Then, the leachate is pumped to the surface of the landfill where it is treated at the landfill site or at a sewage treatment plant. As trash decomposes, gases can be created. These gases can build up and move around under the ground and eventually escape into the environment. To prevent this from happening, the gases are vented safely through pipes.

Everyday as garbage is brought to the landfill, it is spread and crushed by a bulldozer or **compactor**. At the end of the day, the garbage is covered by a layer of soil to cut down on odors and to keep insects and rodents away. Groundwater monitoring wells are dug near the landfill to check the water for contamination.

When landfills reach their capacity (are filled), they are capped with a seal of clay and two to five feet of soil, and grass is planted on the site. Some closed landfills are turned into parks, playgrounds, or even golf courses and ski slopes. Landfills are tested for leachate and gas control for many years after they have been closed.

Landfills are specially designed to protect the environment, and they are still necessary to handle our garbage. Unfortunately, there are a few problems concerned with landfills. Landfills must be close to a community, but many people do not want new landfills built near their homes. If landfills are not properly designed and managed, they can cause pollution problems. Hopefully, in the future, there will be less of a need for new landfills, as people change their habits and reduce garbage.

Incineration

To incinerate means to burn to ashes. When waste is burned in an incinerator, the remaining ashes take up less space in our landfills which extends the life of our existing landfills. Burning waste can create heat, which may be used to produce steam. The steam can generate electricity for homes and

businesses. Incinerators such as this are referred to as waste-to-energy plants.

Ash from the incinerator must be tested and disposed of in a landfill. Sometimes special landfills are made just for ash disposal. Gases may be emitted to the air by the incinerator and cause pollution, so the gases must be controlled through complex filter systems and careful testing. Not all materials can be incinerated.

Incinerators can reduce the amount of waste that goes to landfills. In Illinois, 2 percent of our waste is incinerated. Incineration is a very controversial issue. Many people are opposed to incinerators, because they can be sources of air pollution.

The IEPA continues to study incinerators and how they can be safely constructed to handle the waste problem.

The Hazardous Waste Puzzle

Hazardous waste can be a solid, liquid, or gas. Waste is considered hazardous if it is toxic (poisonous), corrosive (can eat away the container which holds it), ignitable (can catch on fire and burn), or reactive (can explode). Because they can be harmful to human beings or the environment when not handled properly, hazardous waste requires special handling when being produced, stored, transported or disposed of.

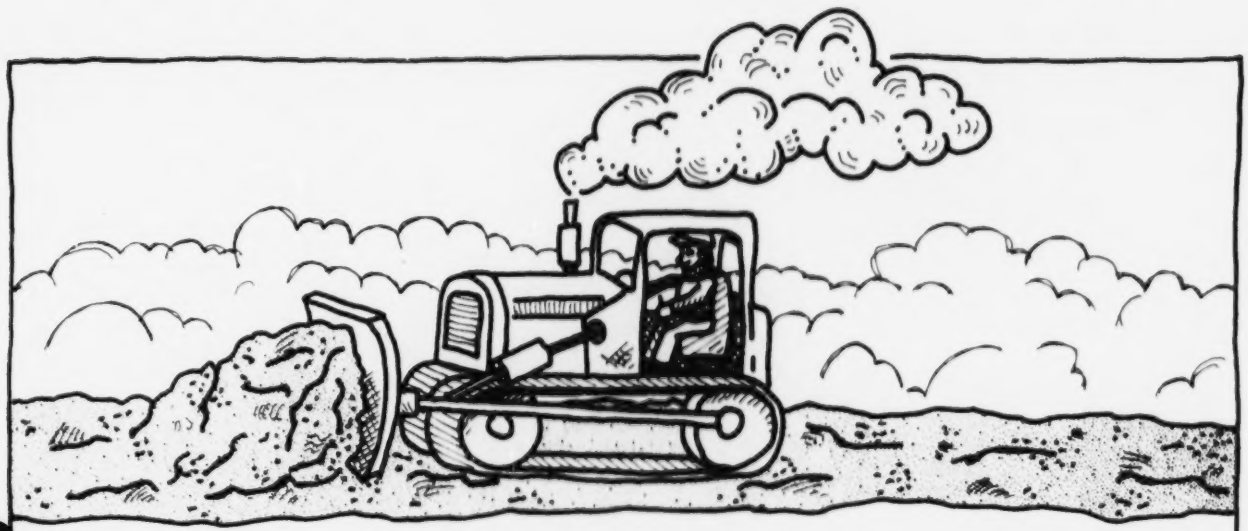
Hazardous waste can come from many sources. Manufacturers use many chemicals to create their products *(See Handout 3D, Hazardous Waste Sources)*. The leftover waste products can be hazardous. Both big industries, like automobile and computer companies, and small businesses, like dry cleaners or photo shops, can make hazardous waste. About 10 to 15 percent of all wastes generated in the United States are hazardous.

We cannot stop producing hazardous waste; however, we can reduce the amount that we do produce through careful management.

The fact is the production of telephones, televisions, computers, bicycles, and other items that we use every day generates some hazardous waste. If we want to continue to use these products, we have to find ways to solve the hazardous waste problem. Fortunately, there are solutions.

Handout 3B

Layers of the Landfill



Final Earth Cover

Compacted Solid Waste

Daily Earth Cover

Compacted Solid Waste

Daily Earth Cover

Compacted Solid Waste

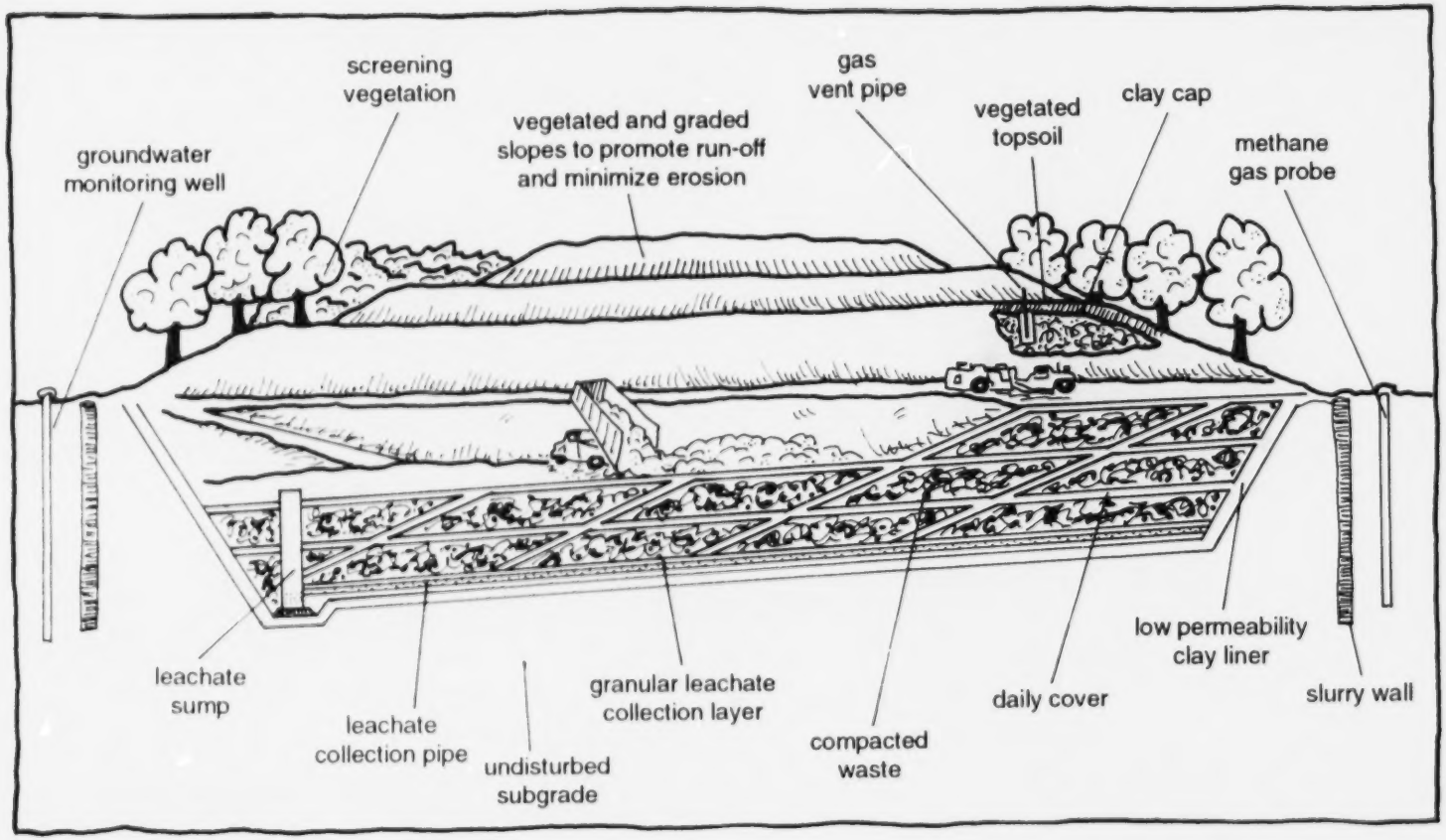
Daily Earth Cover

Compacted Solid Waste

Protective Liner

Handout 3C

Landfill Diagram



Handout 3D

HAZARDOUS WASTE SOURCES

The products we use . . . . . create these hazardous wastes

PLASTICS	Organic Chlorine Compounds
PESTICIDES	Organic Chlorine Compounds Organic Phosphate
MEDICINES	Organic Solvents Heavy Metals
PAINTS	Heavy Metals Organic Residues Pigments, Solvents
PETROLEUM PRODUCTS	Oil Phenol Heavy Metals Ammonia Salts Acids Caustics
METALS	Heavy Metals Fluoride Cyanide Acids Solvents
LEATHER	Heavy Metals Organic Solvents

Methods of Dealing with Hazardous Waste:

- Some industries can change the way they make products to REDUCE the amount of hazardous wastes produced.
- Some industrial waste can be RECYCLED.
- Burning at high temperatures (INCINERATION) destroys some hazardous waste.
- Wastes that cannot be taken care of in any other way can be safely disposed of in a HAZARDOUS WASTE LANDFILL.

Medical Waste

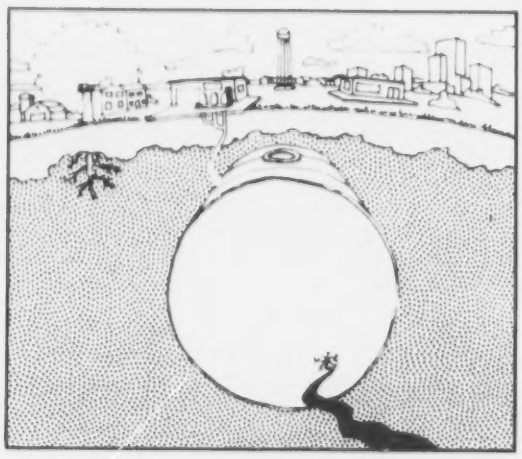
Hypodermic needles or other items that are used and thrown away by doctors and nurses are considered medical waste. Most of this waste is labeled, "POTENTIALLY INFECTIOUS MEDICAL WASTE" and "MEDICAL WASTE", or it is waste that is thrown away in a red plastic bag and labeled "BIOHAZARD."

If you ever find a needle in a haystack...or anywhere else ...do not touch it. Hypodermic needles and other medical waste can hurt you. Besides getting stuck by a needle, you can catch diseases from any garbage that has been used to test or to treat people that are sick. Many of these diseases can make you very sick or even kill you, so it is very important to never touch medical waste.

If you see any medical waste lying by the roadside, on the beach, in a trash can, or dumped in other places, do NOT touch it! Have someone in your family call your local police department or the IEPA.

Leaking Underground Storage Tanks

Is This Tank Under Your Town? If it is, you could have gasoline or other harmful chemicals in your drinking water.



Millions of storage tanks are buried beneath cities and towns all across America. Many of these underground tanks are leaking gasoline and dangerous chemicals into the soil and groundwater.

Half of all Americans get their drinking water from groundwater. Just one leaking tank in your town can make your whole drinking water supply unsafe to drink. The gasoline and other chemicals that were in the tank can contaminate the water.

To protect you, the government now requires tank owners (such as gas/service stations) to replace their underground tanks with newer equipment and frequently check the tanks for leaks.

You can help. If you see, smell, or taste gasoline where it shouldn't be, call your local fire department or the IEPA.

Household Hazardous Waste

Many products commonly found in homes can be harmful or hazardous if they are not used or disposed of properly and safely. When these products are no longer useful and are thrown away, they are called household hazardous waste. Household hazardous waste can contaminate the air, water, and land. They also can be a health risk to humans and pets. Some examples of household hazardous wastes are lawn care products, cleaning products, paints, and automotive products.

These wastes contain ingredients that are corrosive, ignitable, reactive, or toxic. Of course, some wastes can be in more than one category. There are four signal words that are used on household product labels *(See Handout 3E, What's on a Label?)*. The four signal words are: CAUTION, WARNING (most common), DANGER and POISON (least common). Next to the signal word on a product label is information concerning the potential injury from improper use of a product and this is followed by first aid information.

Even though it is not against the law to dispose of household hazardous waste in the garbage, it is not the best environmental thing to do. If we would purchase only the amounts that we need of these products, there would be nothing to throw away, or we can use non-hazardous products in our homes.

Reduce waste at the source: BUY ONLY WHAT YOU NEED.

When it is necessary to dispose of household hazardous waste:

THINK BEFORE YOU THROW IT OUT!

And always READ and FOLLOW label directions!

Except for medicines and a few pesticides, some leftover household products can be given to a neighbor or local group who can use it. Each year the IEPA conducts household hazardous waste collection projects in selected communities in Illinois. People can bring their waste to the collection site, and it will be disposed of in an environmentally safe manner. However, many communities don't provide this service, so you may have to store the product in your home or garage in a safe area that has good air circulation.

Hazardous wastes should NEVER be poured down the sink, on the ground, or into storm drains, or into ANY stream, river or lake.

Handout 3E

What's on a Label?

PROOF OF PURCHASE
(FOLD & TEAR ON DOTTED LINE)

40

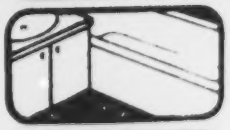
ALL PURPOSE CLEANER

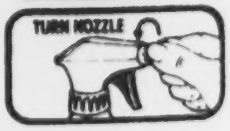
← Product Name

← Product Type

CUTS GREASY DIRT FAST!

WIPES AWAY DIRT AND GREASE STAINS including Heel Marks, Crayon, Fingerprints, Food Stains, and Soap Scum on Most Washable Surfaces around your House, both Inside and Out!





Where to Use the Product:
- KITCHEN & HOUSEHOLD Refrigerators, Counters, Stoves, Stove Hoods, Walls, Window Sills, Floors, Doors, Cupboards, Woodwork
- BATHROOMS Ceramic Tile, Sinks, Showers, Tubs, Cabinets

Direction for Use:
- JUST SPRAY & WIPE! No rinsing needed. For Big Jobs use the Economical 64oz. size 40
- TO OPERATE Turn nozzle counter clockwise to "Spray" or "Stream." Adjust to desired pattern.

NOTE 40 is safe on most washable surfaces. However, on painted surfaces test a small area. Not recommended for use on soft vinyl, varnishes or aluminum. If applied on those surfaces, rinse and wipe dry immediately.

Human Safety Information → CAUTION: MAY BE IRRITATING TO THE EYES UPON DIRECT CONTACT. In case of eye contact, flush eyes with plenty of water for 15 minutes. If swallowed, drink a glassful of water. Call a physician. **KEEP OUT OF REACH OF CHILDREN.**

Ingredients → Ingredients: Water, detergents, builder, grease cutter & color
CONTAINS NO PHOSPHORUS

Clean Air, Land and Water -- THANKS TO TREES

The quality of the world around us, the air, soil and water, depends on the roles trees play in our environment. Trees clean the air we breathe because they take in carbon dioxide through their leaves and give off the oxygen we need to breathe. *(Handout 3F, How a Tree Works).* An acre of trees produce enough oxygen for 18 people to live every day, and an acre of trees also absorb enough carbon dioxide, over a year's time, to equal the amount you produced when a car is driven 26,000 miles. If trees didn't breathe, neither could we.

Trees help to trap and hold particulate pollutants (dust, ash, pollen and smoke) that can damage the human lungs. This particulate matter is trapped and filtered by leaves, stems and twigs and washed to the ground by the rainfall.

Under every tree, there is a root system that extends two to four times farther than the branches of the trees. Attached to every root are tiny root hairs. They act like miniature straws to draw up water and nutrients. This mixture is sent up the tree to the leaves and helps the tree grow. Tree roots hold soil in place to prevent erosion which not only saves soil, but also helps keep our rivers, streams and lakes cleaner. Water is much cleaner when there are lots of trees nearby.

When trees that grow on the banks of lakes or streams die, they drop their branches into the water. Eventually, the tree may fall into the water. These branches and trees make excellent places for small fish to hide, a place where many fish raise their young, and a very good hunting ground for larger fish.

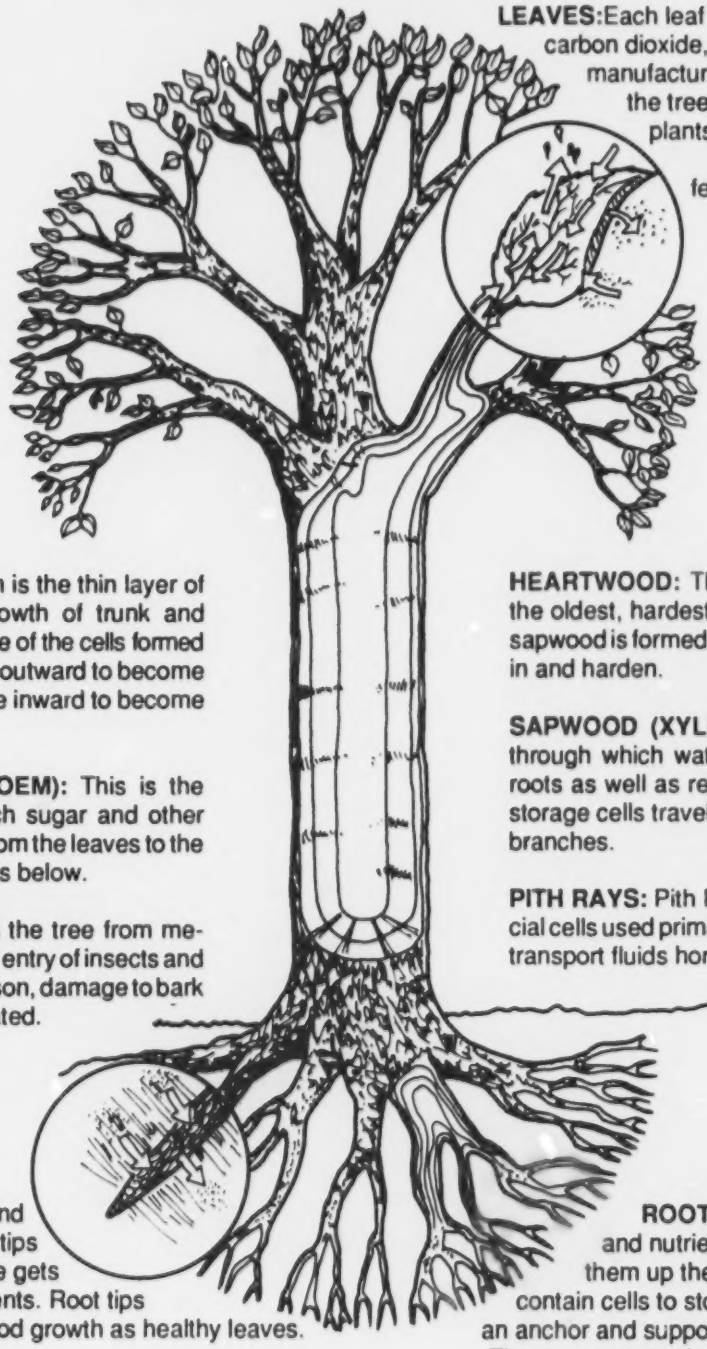
Trees provide shade in the summer to help keep our homes, schools and businesses cool. They block the wind in the winter which makes it easier to warm our homes. This reduces the amount of fossil fuels burned to produce electricity for heaters and air conditioners, and this helps protect the air and prevent global warming.

Eventually, all trees die and fall to the ground. Insects, animals and bacteria continue to live in the trees as they decay. Finally the tree decays completely and returns its nutrients to the soil. Good soil is made up of older plants that have died. Dead trees live on as part of new plants and trees, providing new homes for insects, birds, and animals.

Trees are one of Illinois' most valuable resources. They improve air and water quality, **biodiversity**, wildlife habitats, and recreational opportunities. Trees improve the beauty of our yards and parks, reduce soil erosion, and provide many valuable wood products. They also contribute to energy conservation by shading and cooling buildings and serving as windbreaks. Trees provide us with colors, flowers, and beautiful shapes, forms and textures. Trees add character to our cities and towns. Without trees, cities are barren landscapes of concrete, steel and asphalt. Think about what you like about trees and how they are important to your life.

Handout 3F

HOW A TREE WORKS



LEAVES: Each leaf is a food factory that uses carbon dioxide, water and solar energy to manufacture sugar, the basic food for the tree. Photosynthesis by green plants is the basic, fundamental link in the food chain that feeds all plants and animals in the world.

CAMBIUM: Cambium is the thin layer of cells in which all growth of trunk and branches occurs. Some of the cells formed in the cambium move outward to become bark, and others move inward to become sapwood.

INNER BARK (PHLOEM): This is the pipeline through which sugar and other materials flow down from the leaves to the roots and storage cells below.

BARK: Bark protects the tree from mechanical injury and the entry of insects and diseases. For this reason, damage to bark should always be treated.

HEARTWOOD: This supports the tree. It is the oldest, hardest wood in the tree. As new sapwood is formed, the older sapwood cells fill in and harden.

SAPWOOD (XYLEM): This is the pipeline through which water and nutrients from the roots as well as reserve food from the tree's storage cells travel upward to the leaves and branches.

PITH RAYS: Pith Rays are the areas of special cells used primarily for food storage and to transport fluids horizontally.

ROOT TIPS: Roots end in millions of tiny root tips through which the tree gets all its water and nutrients. Root tips are as essential to good growth as healthy leaves.

ROOTS: The roots collect water and nutrients from the soil and send them up the trunk to the leaves. They contain cells to store sugars and also act as an anchor and support to hold the tree upright. The root system of a tree is usually longer and more branched than its top.

60

A Lot of Leaves

Each fall when the **deciduous** trees drop their leaves, it is a challenge to decide what to do with all of those leaves. This is especially a challenge in urban areas. One thing that people can do is to burn the leaves. Leaf burning is a controversial environmental issue in Illinois. Some people like the smell of burning leaves in the crisp, autumn air, but some people suffering from respiratory illnesses (such as asthma) find that the air pollution caused by burning leaves makes breathing difficult.

Many local governments do not allow the burning of leaves, and the IEPA has a few rules for leaf burning:

Leaves cannot be taken from your yard and burned somewhere else unless it is at a place where your local government permits leaf burning.

Local governments can specify the times and/or weather conditions during which leaves may be burned.

When leaves are burned, particulate matter such as smoke, soot, and ashes are released into the air. When this particulate matter is inhaled, it may irritate the respiratory system or damage the lungs. Particulate matter from leaf burning can also be a problem when it settles on cars, homes, patios, etc., and creates a film of soot that causes the surface to appear dirty.

Since leaf burning is legal in some parts of the state, the IEPA recommends that leaf burners:

Consider your NEIGHBORS. Elderly people, people with heart or respiratory problems and infants may be affected by the smoke from the burning of leaves.

NEVER allow leaves to burn without someone watching them.

Do NOT burn leaves during strong winds. The fire can easily get out of control.

Only burn leaves during the DAY.

Do NOT burn wet leaves or other wastes such as paper with your leaves.

You may be asking what can you do instead of burning leaves? Read Chapter 5 and you will discover an alternative to leaf burning.

Illinois Coal

From the earliest days of the state's history, coal has not only been a fuel for the homes and businesses in Illinois, but it also has been important to the state's economy and culture. The black treasure from the earth was first discovered in Illinois more than 300 years ago, and mining began almost 200 years ago. Illinois contains 17 percent of the coal in the United States, and only the state of Montana contains more coal than Illinois. Illinois ranks fifth in the country in the amount of coal that is actually mined. There are 40 coal mines in Illinois that provide more than 12,500 jobs, and there are an additional 25,000 coal-related jobs in the state.

Throughout history, coal has had a variety of uses. In the 1800s, the largest use of coal was for the production of steel. With the invention of the steam engine, coal became the fuel that provided energy for steam locomotion. This energy was used in manufacturing goods and services such as textiles, metals, food, and printing.

By the 1900s, there was an increased need for coal. It was around that time that most of our inventions that use electricity were created. When electricity first began to be used in homes, it was, as now, mostly generated by burning fossil fuels such as coal. Some of the inventions made possible by electricity produced by fossil fuels are the light bulb, sewing machine, vacuum cleaner, refrigerator and dishwasher.

The Importance of Coal

Coal is still the number one fuel used to produce electricity. Today, coal is also used as an energy source for a variety of industries such as in making steel, plastics, fertilizers, medicines, concrete and paper.

The abundant supply of coal has made the United States one of the richest nations on earth. The United States produces 25 percent of the world's coal (more than any other country). The United States contains enough coal to meet our needs for another 250 to 300 years.

How Coal is Formed

It appears that we have a large supply of coal available, but the coal we are using today took millions of years to form. In this sense, coal is a limited natural resource that we should conserve. So, how is this fossil fuel formed?

Vegetation (plants) grew in swamps which covered many parts of North America about 300 million years ago. The vegetation absorbed and stored the sun's energy. Vast amounts of vegetation died and piled up at the bottoms of swamps to form a spongy, brown material called peat. Sediment and rock buried the peat deep under the surface of the earth. There the layers of peat were further packed down by the weight and heat of the sediment and rock which squeezed the water from the peat. After millions of years under the earth's surface, the weight and pressure turned the peat into coal. The

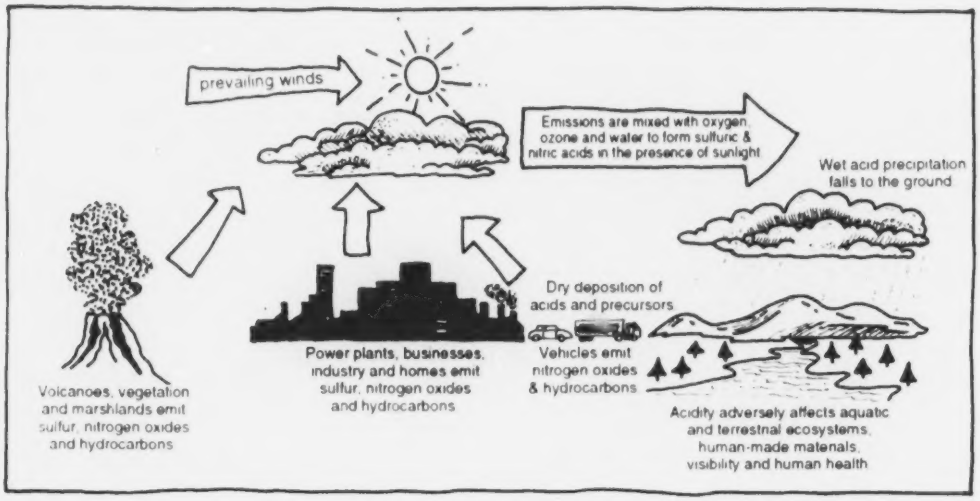
greater the heat and pressure, the harder the coal. There are four major types of coal: lignite (softest coal), sub-bituminous (medium-soft coal), bituminous (medium-hard coal), and anthracite (hardest coal). Illinois contains bituminous coal.

Coal and the Environment

Although coal is plentiful and useful, it also can have bad effects on the environment if it is not mined and used safely and carefully. For instance, there are laws that require land that was used for the surface mining of coal to be "reclaimed." To reclaim the land means that once the coal from a section of land is mined, the pit from the mining has to be filled in with soil and replanted to prevent erosion. As a result, the land is then usable for other purposes such as for homes and farms, and is not left as an ugly environmental problem.

Coal mining also can cause water pollution. When rain falls on coal piles or drains from mines, an acid forms that can flow into nearby surface water or seep into groundwater and pollute the water. Few fish, plants, or other organisms can live in this acid water.

One of the biggest environmental issues related to coal mining is acid rain. Coal is mostly made up of carbon, a basic element found in all living things. But coal also contains sulfur. Sulfur, in its pure form, is a very useful chemical. It is often used in drugs prescribed by doctors to treat illness. But when coal burns, the sulfur breaks loose and forms a foul-smelling gas. In the air, sulfur gases can combine with water vapor (visible particles of moisture floating in the air) and form an acid that can fall to earth as "acid rain." Right now, "acid rain" is mainly a problem only in the northeastern part of North America.


prevailing winds
Emissions are mixed with oxygen, ozone and water to form sulfuric & nitric acids in the presence of sunlight
Wet acid precipitation falls to the ground
Dry deposition of acids and precursors
Volcanoes, vegetation and marshlands emit sulfur, nitrogen oxides and hydrocarbons
Power plants, businesses, industry and homes emit sulfur, nitrogen oxides and hydrocarbons
Vehicles emit nitrogen oxides & hydrocarbons
Acidity adversely affects aquatic and terrestrial ecosystems, human-made materials, visibility and human health

Formation of Acid Rain

The problem with acid rain is that it can travel great distances and can pollute lakes, forests, soil, air, and manmade materials such as metal and paint. The pollution caused by acid rain has been, and will continue to be, studied and debated by scientists for years to come.

Some types of coal are low in sulfur and can be burned with little pollution. Other types of coal, such as Illinois coal, have higher amounts of sulfur that must be removed. Today, new equipment and coal burning methods are being used to remove the sulfur from the coal and reduce air pollution. This is required by the **Clean Air Act** in order to prevent the problem of acid rain.

Environment vs. People

Many people view the issue of acid rain as a battle between the environment and jobs for people. The equipment used to remove sulfur from Illinois coal and prevent acid rain is very expensive. Some companies cannot afford the equipment and may switch to burning coal from other states that is low in sulfur. This may mean a loss in coal mining jobs in Illinois.

The Future

Is coal a fuel for the 21st century? Coal is our most abundant fossil fuel resource in Illinois, with a supply that will last hundreds of years. Coal provides Illinois with millions of dollars and thousands of jobs. However, the mining and burning of coal also can pollute the air, water and land. The issue of acid rain must continue to be studied, along with how the burning of high sulfur coal may contribute to this environmental problem. The new environmental technologies that are being developed for coal mining and burning may help make coal an important part of Illinois' future.

Environmental Laws and Regulations

The Illinois Environmental Protection Agency (IEPA) was created in 1970 to help solve environmental problems in the state of Illinois. Laws have been created in Illinois and Washington, D.C., to stop air, water, and land pollution. The IEPA works with other government departments and offices and with businesses and citizens to solve environmental problems.

The IEPA is responsible for enforcing environmental laws that are designed to protect human health and welfare, as well as wildlife, and the air, water, and land of Illinois. Illinois environmental laws must always be as strict as the rules that apply to all of the United States. This chapter will focus on rules (laws) to protect the public and the environment that you many not violate.

Bureau of Water

The Bureau of Water at the IEPA is responsible for protecting the water that we drink and making sure that Illinois rivers, streams, lakes, and groundwater stay clean. When it comes to drinking water, this is not an easy job since there are about 1,900 public water supply systems in Illinois that deliver approximately 2 billion gallons of safe drinking water every day. Most of the 1,900 water supplies pump groundwater from wells for treatment and distribution to consumers.

The Safe Drinking Water Act is a federal law that creates strict requirements for drinking water. Your local water supply system must not have high levels of several different pollutants.

The Clean Water Act is another federal law. It provides protection for all water of the United States from water pollution. The law is carried out by the states and the U.S. Environmental Protection Agency. Illinois has water quality rules that protect fish and other aquatic life, and rivers and lakes for fishing and swimming.

The Illinois Groundwater Protection Act was passed in 1986 in response to groundwater concerns in the state, and it set up a groundwater protection policy for Illinois. The Act provides an opportunity for local governments to become involved in protecting their community water wells from contamination.

Here are some of the rules you cannot break when it comes to water pollution:

Open dumping - You cannot open dump garbage of any kind, leaves or grass clippings, or animal waste into rivers, streams, or lakes.

Wastewater - Wastewater (raw sewage) cannot be dumped into waterways unless it has been treated with chemicals.

Public water supplies - A public water supply must meet federal rules to provide safe drinking water and cannot knowingly give contaminated water to residents. These water supplies must test for pollutants. For example, water supplies must test for lead and if the levels are too high, they must treat the water so it does not leach (dissolve) lead from water pipes.

Wetlands - You cannot fill in (with soil or rock) or drain a wetland without consulting with (obtaining a **permit** from) the IEPA.

Chemical spills - Major chemical spills (fertilizers, petroleum, etc.) or spills of other **foreign** materials that occur on land or water must be reported to the IEPA or other state and federal authorities.

Bureau of Land

The IEPA's Bureau of Land makes sure that household garbage and hazardous wastes are handled in an environmentally safe manner and encourages the recycling of materials. The Bureau also works to clean up problem toxic waste sites.

Under the Resource Conservation and Recovery Act, the IEPA works with the federal government for the safe disposal of solid and hazardous waste. The law also encourages recycling, cleanup of underground storage tank spills, and following the movement of

hazardous waste (for example, from a factory to a landfill for disposal).

Another law, known as Superfund, authorizes the federal government to handle waste problems that endanger public health or the environment. Forty sites in Illinois are on the Superfund list, meaning they qualify for federal money to clean up the sites.

In Illinois, the Solid Waste Management Act of 1986 was created not only to solve the problem of not having enough space in landfills, but also to encourage the recycling and reuse of materials. The Act provides money to local governments to develop their own plans to recycle waste. Every county in Illinois must have a recycling plan by March 1, 1995. The money is also used by communities to inspect landfills and open dumping sites. The Act requires the IEPA to prepare a report each year about the number landfills in Illinois and how much space is left in those landfills.

Here are some rules that you cannot break when it comes to land pollution:

Open dumping - People throw out piles of trash and in many cases, the material is found at the bottom of ravines, in empty lots or pastures, or along the roadside. This is very different than a landfill, which it constructed to make sure the environment is not hurt (see Chapter 3, *Waste Management-A Problem for All of Us*). The IEPA responds to about 800 complaints of open dumping each year. Open dumping is illegal because these dumps can cause explosions, fires, bodily injury to children playing nearby, water pollution, and damage to plants and wildlife. Please report open dumping to local law enforcement authorities, local health departments, or the IEPA.

Some items cannot go into landfills - Currently, car batteries and landscape waste (tree limbs, leaves, grass) are not allowed to be disposed of in landfills. In the next few years, tires, used motor oil, parts from metal appliances, and most packaging that contains toxics, will also be banned from landfills.

Underground storage tanks - People who own land where there is an underground storage tank (generally they hold gasoline) must report any spills or leaks from that tank to the IEPA.

Hazardous waste - If you want to haul hazardous waste in trucks, you must be licensed by the IEPA. Also, you must keep track of where that toxic waste is going to make sure it does not end up in the wrong place.

Bureau of Air

The Bureau of Air's main job is to identify and control air pollution problems in Illinois, propose stricter rules to protect our air, and to inspect facilities

that have permits to emit some pollutants to air. The Bureau also oversees the testing of vehicles in order to reduce air pollution from automobile emissions. The testing is done in the Chicago and East St. Louis areas, because those are regions of the state that have air quality problems. The test consists of sampling tailpipe emissions for levels of carbon monoxide and **hydrocarbons**.

The Clean Air Act is a law which allows the federal government and the IEPA to protect the public from air pollution. The Clean Air Act contains standards (or the amounts of pollutants that can be safely emitted to the air) for six major pollutants in Illinois, including: asbestos, carbon monoxide, nitrogen dioxide, ozone, particulate matter, and sulfur dioxide. The Act says each state must work for clean air by developing a plan that identifies ways to improve air quality.

Here are some rules you cannot break when it comes to air pollution:

Open burning - Citizens or companies cannot burn potentially dangerous materials without a permit from the IEPA. Illinois currently has no general law that prohibits open burning of leaves or tree branches, but many cities and counties have their own law. The IEPA recommends that citizens try composting their leaves and other yard and garden waste as an alternative to burning. Also, household trash should not be burned by citizens or farmers.

Vapor recovery - Service/gasoline station owners in the Chicago area are responsible for installing a new nozzle on gasoline tanks that will keep gas fumes from escaping into the air and will send them back to the underground storage tank below the service station. These gasoline vapors are major sources of air pollution.

Vehicle emissions testing - Car owners in the Chicago and East St. Louis areas are required to have their automobiles tested for air pollution starting when the automobiles are three years old. Automobiles are also tested for gas caps and **catalytic converters** that are damaged or have been removed from the automobile. Vehicles that do not pass the test must have mechanical repairs done before they can be legally driven on the road. If a person does not have his/her vehicle tested, the license plates may be suspended, which means that the vehicle cannot be legally driven.

Carpooling - This program requires businesses in the Chicago area that employ more than 100 people to reduce the number of automobiles going to their office building. For example, more employees of a company may use buses or trains for transportation to work, set up a carpooling system where people ride to work together, or arrange for shuttle buses to pick up employees. The program will result in less air pollution because there will be fewer automobiles on the road.

Breaking the Rules

While it would be great if all communities, businesses, industries, and citizens would follow our environmental laws, unfortunately, there are some who break the rules. In those cases, the IEPA's employees in 11 field offices throughout the state of Illinois conduct investigations of pollution problems. The IEPA also relies on complaints from citizens like you and investigates those complaints. If the problem is not solved, the IEPA's lawyers could take legal action to correct the problem. Polluters who break environmental laws can be fined thousands of dollars for each violation, or if they know they are breaking the rules, they can be sent to jail.

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Worksheet

WORD SEARCH

Students should locate the 14 hidden words in the puzzle. Each word was discussed in Chapter 4- *Environmental Laws and Regulations.* The words are spelled forward and drawkcab (backward) and can be found vertically (I), horizontally (-), and diagonally (/).

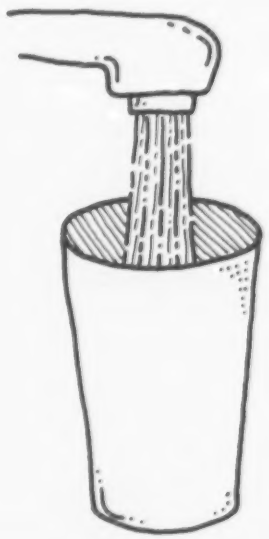
IEPA	G	N	I	P	M	U	D	N	E	P	O
LAWS	N	R	Z	V	E	H	I	C	L	E	S
WATER	I	S	O	T	S	E	B	S	A	Q	P
GROUNDWATER	L	G	S	U	P	E	R	F	U	N	D
WETLANDS	C	V	S	D	N	A	L	T	E	W	O
LAND	Y	U	L	A	N	D	F	I	L	L	S
RECYCLING	C	J	A	K	S	B	W	L	W	A	F
SUPERFUND	E	F	N	M	R	E	T	A	W	A	L
LANDFILLS	R	T	D	H	Q	I	Y	W	T	P	L
OPEN DUMPING	I	A	I	V	K	C	P	S	B	E	N
AIR	A	L	E	A	V	E	S	Z	T	I	R
ASBESTOS											
LEAVES											
VEHICLES											

5

Resource Conservation and Pollution Prevention

You have learned a lot about the air, water and land of Illinois, about some important environmental issues and how we depend on the environment to survive. From this chapter, you will learn about what the Illinois Environmental Protection Agency is doing to clean the environment through resource conservation and pollution prevention, and what you can do to help. The term resource conservation refers to using human and natural resources carefully and avoiding waste. Recycling is an example of conservation. Prevention means to stop pollution or reduce the amount of pollution. An example of prevention is the exchange of leftover materials between companies so the materials are reused, and there is less to be disposed of in a landfill.

Be Water Wise

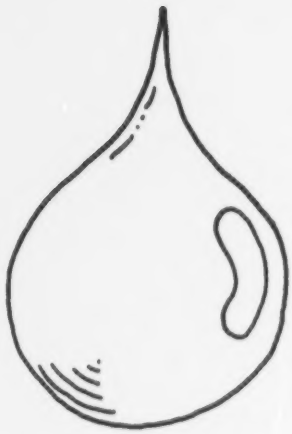


We all need water to live.3 The average person uses 80 to 100 gallons of water each day. You only need about two and a half quarts of water each day in order to live. So the rest of the water we use each day isn't necessary for our survival; it just makes our life easier.

How Much Water Do You Use?

You start using water in the morning when you get up. You may take a bath or shower. After breakfast you may start the dishwasher or wash the family's morning dishes in the sink. At school, you drink water from the fountain and possibly wash your hands after recess. You may go to the bathroom after lunch. When you go

home after school you may realize that your ball uniform is dirty, and you need to wear it to a game that night. So, you throw your uniform into the washing machine. After supper you probably brush your teeth and wash your face before you go to bed. Believe it or not, you may have used more than 80 gallons of water during that day!



Make Every Drop Count

There are many ways to conserve water or to reduce the amount of water we use at home, school, work and other places we visit. It's important that we think before we turn on the water and make every drop count. Look at the following examples below. Do these water activities relate to you or a member of your family?

1. *Waiting a week to fix a leaky faucet.*
2. *Watering your lawn at noon.*
3. *Using your garbage disposal all the time.*

If you are guilty of some or all of these water activities, then you need to learn about the following ways that you and your family can conserve water:

- ✔ *Check for leaky faucets and toilets.* While you're waiting a week to fix a leaky faucet, the faucet can drip 140 gallons of water. You can lose up to 200 gallons of water a day from a leaking toilet.

- ✔ *Turning the lawn sprinkler on at noon is not a good idea.* The hot sun evaporates the water your lawn needs. It is usually better to water early in the morning when water evaporates more slowly.

- ✔ *A garbage disposal uses one gallon of water per minute.* Many food scraps can be composted. This not only saves water, but also produces a rich material to put on your flowers and garden.

- ✔ *You can use more than 35 gallons of water in the shower or bathtub.* So, take shorter showers or use less water in the bathtub.

- ✔ *Turn off the water in the shower while soaping up and shampooing your hair.*

- ✔ *A faucet allows up to five gallons a minute of water to flow down the drain.* You can save a lot of water by turning off the faucet and not

letting the water run continuously when you brush your teeth or wash your face.

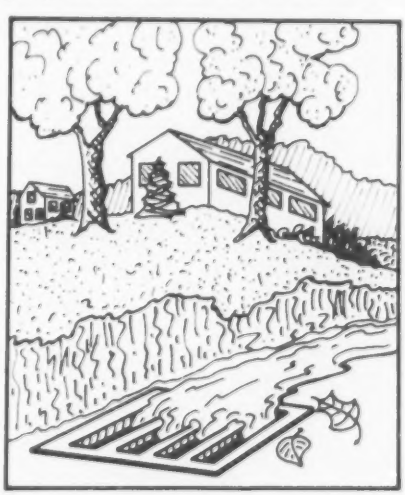
- ✔ *Washing machines and dishwashers should only be used with full loads.*
- ✔ *Install water-saving shower heads.*
- ✔ *Install toilet devices that reduce the amount of water used to flush wastes,* or when buying a new toilet, buy a low-flow toilet (uses less than five gallons per flush instead of seven gallons).

Leaking faucets, hoses, and pipes are the biggest water wasters in your home. Conservation is one way to stop this waste, and there are also many devices that can help save water. These devices will more than pay for themselves in the amount of water (and money) they will save. Items that help save on the amount of water used by toilets, showers, washing machines, and lawn sprinklers are usually inexpensive and easy to install.

The other way you can conserve involves the way you think about water. Be creative in looking for ways to cut back on the amount of water you use. Good examples are keeping a pitcher of water in the refrigerator so you don't have to run the tap water to get it cold, using a bucket to wash the car instead of running water from a hose, or planting grass, flowers, shrubs, and trees that require little water in your yard, school, or park .

Nonpoint Source Pollution and You

As we learned in Chapter 3, nonpoint source pollution is polluted water that runs off from places such as agricultural fields, livestock feedlots, construction sites, city streets, mines, and logging operations. Each of us, whether we know it or not, contributes to nonpoint source pollution through our daily activities. Because of this, nonpoint source pollution is the biggest threat to many of our ponds, wetlands, rivers, streams, and lakes in Illinois.



But there is good news. In our everyday activities we can also prevent, or stop, nonpoint source pollution and keep our environment clean. Small changes in your life can make a big difference in the quality of Illinois' water resources. Most nonpoint source pollution in your neighborhood is caused by

the runoff of stormwater, which is rain and melting snow that flows across the ground and pavement in urban areas. The stormwater can carry pollutants into storm sewers. Storm sewers are the drains that you see on your streets, and this water is carried through miles of pipes to nearby rivers, streams and lakes. Here are just a few ways that you can reduce nonpoint source pollution in your neighborhood.

Litter - Place litter, including cigarette butts, in trash containers. Never throw litter in streets or down storm drains.

Fertilizers - Fertilizers contain nitrates and phosphates that, in abundance, cause an overgrowth of algae in rivers and lakes which can lead to fish kills. Avoid overuse of fertilizers, and do not apply them on your lawn or garden when it seems likely to rain. The fertilizers can easily wash away. Consider using manure or compost instead of fertilizers.

Pesticides - Many products made to kill pests in your home or yard are also toxic to humans, other animals, aquatic organisms, and plants. Follow the directions on the label of these products carefully. Do not overuse pesticides.

Household Hazardous Waste - Many common household products (paint thinner, moth balls, oven cleaner, etc.) contain toxic ingredients. Never pour these products on your lawn, on your driveway, or down the storm drain.

Motor Oil - Motor oil contains toxic chemicals that are harmful to animals, including humans, and fish. When changing the oil in a car, do not dump the used motor oil down storm drains, on the driveway or the ground. Put the motor oil in a container and take it to a service station for recycling.

Car Washing - Many car detergents contain phosphates that can pollute water. Use only non-phosphate detergents when washing a car.

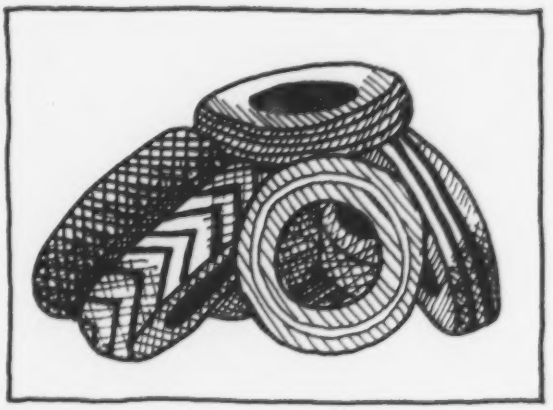
Pet Waste - Animal wastes contain bacteria and viruses that can contaminate aquatic organisms and cause swimming areas in lakes and rivers to be closed. Pet owners should clean up animal waste with a newspaper or scooper and place in the garbage.

Leaves and Grass - Never dump leaves or grass into the street. The rain will wash them into the storm drain. This can clog the storm drain. When the leaves and grass enter a body of water, their decomposition uses oxygen which could cause a fish kill.

Lake and Stream Banks - If you live near a stream or lake, you can protect it from nonpoint source pollution by removing trash from the water, keeping humans, cars, and farm animals away from the edge of the water, building steps or a ramp to the water, which protects the bank from erosion, and planting vegetation on the banks to hold the soil. These activities protect a stream or lake from the nonpoint source pollution caused by the runoff of soil into the water.

As you can see, these suggestions are simple and easy to practice in your life. Making a couple of these changes can help prevent nonpoint source pollution and result in cleaner water in Illinois.

Everything Deserves a Second Chance - Even Tires



Nearly everyone has heard of recycling used aluminum cans, glass, plastic and newspaper. Many people recycle at home, school, or at work. However, the majority of people do not know that scrap tires are a recyclable product as well. Used tires are being recycled, reused, or made into different products to serve a variety of uses.

Every year in the United States 242 million tires are scrapped, which often means they are disposed of in a landfill. That equals about one tire per person. The state of Illinois produces close to 12 million of these waste tires. Since tires do not easily or quickly degrade or decompose, piles of tires become a real problem.

Used tires also can pose a serious threat to humans and the environment when disposed of improperly. Piles of scrap tires are a perfect breeding ground for mosquitoes and other disease-carrying organisms. Open burning of tires can produce air pollution and can release toxic oils into the soil and groundwater. So, disposal of used tires must be carefully controlled. Marketable ways to reuse this waste also must be found. Illinois has been a leader in finding uses for waste tires.

Shredded scrap tires can be used as tire derived fuel (TDF) to burn with coal in power plants and factories to produce energy. Air pollution is reduced when TDF is blended and burned with coal, so a few companies in the state have begun using TDF.

When the wires are removed from shredded tires, the material can be used instead of gravel, concrete, or wood chips as playground turf. This turf provides a much safer play area because of the cushioning of the rubber. When a glue is added to this material and it is pressed and flattened, the result is "elastocrete"- a flooring material that also can be used for playgrounds and exercise rooms.

Rubber that does not contain wire can also be ground into a sand-like material. This "crumb rubber" is used in rubberized asphalt (an experimental pavement for roads), railroad crossing mats, ink pens, rulers, and in the manufacture of many other products.

Used tires can be retreaded. Retreading a tire involves replacing the grooved surface of a tire with new rubber. Scrap tires also can be recycled to make planters, swings, playground equipment and sandboxes.

The Illinois Environmental Protection Agency (IEPA) is responsible for the transport, storage, disposal and recycling of used tires in the state. The IEPA

has supervised cleanups in all 102 of the state's counties. In the fall of 1993, the largest tire cleanup in the state's history began in Hopkins Park near Kankakee. Nearly 3 million used tires piled on the site are being shredded and will be burned as tire-derived fuel by the Archer Daniels Midland plant in Decatur, Illinois.

As of July 1994, whole used tires will not be allowed to be disposed of in a landfill. This will save valuable landfill space. However, tire stores will take used tires when a customer purchases new ones. These tires will be recycled or reused.

Reduce, Reuse, Recycle - The Three R's

How many throw-away conveniences have you come to enjoy— even taken for granted— in your home, at school, or when you're out having fun? So many that experts have called the United States a "disposable society." Yet those disposable products and other trash also have helped us to set a world record for the mountain of garbage that we produce each year.

For most people, it doesn't seem right to throw something away that can be salvaged and reused. That's the idea behind recycling. Before materials reach the landfill and take up valuable landfill space, we can intercept them and manufacture new, useful products. Today, about 10 percent of our total waste stream— 15 million tons per year— is recovered and recycled.

Many areas of our state are facing a solid waste crisis because there is too much waste and not enough places to dispose of it. At the same time, many communities are finding creative solutions to avoid waste problems.

Each of us can do our share to avoid the garbage problem *(See Handout 5A, Recycling Is As Easy As Taking Out The Garbage)* by practicing the 3 R's of waste reduction:

- ❒ REDUCE the amount of waste you discard; this often begins at the point of purchase. Buy only what you need and be aware that the package is part of the purchase.
- ❒ REUSE containers and purchase reusable products. Before throwing reusable goods away, consider donating them to churches, thrift stores and shelters.

- ❒ RECYCLE by purchasing items that are easily recycled locally. Look for items in packages and containers made of recycled materials.

The Solid Waste Planning and Recycling Act, passed in 1988, requires all counties in the state of Illinois to recycle 25 percent of their garbage by the year 2000. Citizens can contribute to this effort by practicing recycling now. The IEPA is working with all 102 counties in Illinois to develop recycling plans, which will allow them to comply with this requirement.

Here is some information on the four most common recycled materials:

Aluminum cans are widely recycled because it is much cheaper than making new aluminum from bauxite ore. Already, more than half of these cans are reused. In the 1990s, container manufacturers expect to collect 75 percent of the 50 billion beverage cans that are thrown away every year.

Paper is our most common form of waste. Nearly 30 percent of all paper is now reused to make insulation, building materials or other paper products. In all, about 13 million tons are recycled each year, including four million tons that are exported to foreign markets.

Glass bottles and *jars* also are in high demand. About five billion of these are collected and remelted each year to produce new containers. By using "cullet" (crushed glass) instead of new raw materials, manufacturers may be able to reduce the air and water pollution that often occur when new glass is made.

Plastic containers are increasingly finding a second life as fiberfill stuffing for pillows, ski jackets, sleeping bags and automobile seats. As new markets are developed, the recycling rate for plastic soft drink bottles is expected to rise far above today's 20 percent.

Composting Landscape Waste

Landscape waste is grass, leaves, tree limbs, or shrubbery cuttings and other materials that are produced from the care of lawns. What to do with leaves and grass is a question that poses a problem for many people every fall, particularly since landscape waste has been banned from landfills in Illinois since July 1, 1990. The purpose of this ban was to save space in landfills.

The IEPA suggests that, instead of burning this waste, you can help keep the air clean (Chapter 3 discussed how the burning of leaves can cause air pollution.), eliminate the cost of bagging leaves, and produce a valuable garden additive for spring by composting.

Composting is a process that creates an enriching soil additive, called humus, from organic materials, such as leaves and grass, gathered together and left to decompose. Air and water mix with the compost pile in your yard

or school grounds, and bacteria and other **microorganisms** *(See Handout 5B, Microorganisms Of The Compost Pile)* found in nature cause temperatures to rise to around 150 degrees Fahrenheit. This heat cooks the waste and eventually creates humus: a rich, natural fertilizer. Humus is high in carbon and hydrogen, which are important sources of food for lawns, gardens, fields, trees, plants, and vegetables.

In 1992, 418,330 tons of yard waste were composted in Illinois. This amounts to about three percent of the municipal solid waste generated in our state. That total does not include individuals composting at home. It represents the amount of landscape waste composted at facilities that have a permit from the IEPA to operate. If you rake leaves or mow grass, you can compost too.

Building a compost pile is a great way to turn your leaves and grass clippings into rich humus, which can be added to soil in your garden or flower bed and improve soil quality. Adding compost to clay soil helps loosen the soil to allow easier growth of plants.

Compost piles can either be made above or below the ground *(See Handout 5C, Composting: An Alternative To Burning)*. Compost piles are made up of layers of grass and leaves, manure or fertilizer, and soil. The pile should be moist and turned over frequently to help decompose the leaves and grass. Compost piles are easy to make, and the humus they produce will help your plants grow.

Cash-for-Clunkers

You learned in Chapter 1 that an automobile produces emissions that pollute the air. Since there are about 8 million vehicles registered in Illinois, the IEPA is developing many exciting programs that will help us to enjoy our cars, while also protecting the environment. These programs are part of the IEPA's goal to prevent pollution and expand recycling in Illinois.

Older cars produce more air emissions than newer cars because newer automobiles are specially made to reduce pollution. However, there still are many older cars on the road that are emitting harmful pollution into the air. That is why the IEPA and seven companies in Illinois started a special test project to get old "clunker" cars off the road. More than 200 clunker cars were purchased from their owners for about $800 each.

The cars were drained of harmful fluids, such as gasoline, oil and freon (which is used to cool the car when the air conditioner is running). The old clunker cars were then sold to scrap yards where they were crushed, so they

could no longer pollute the air. This test project was so successful that 50 tons of harmful pollution were kept out of Chicago's air.

Ethanol

Many of the harmful pollutants that automobiles emit into the air are caused by the burning of fuels. Fuel such as gasoline is used to make the cars and trucks run. The IEPA supports the use of a special fuel made from corn called ethanol.

In addition to improving air quality, ethanol production can help Illinois' economy because farmers would be able to sell more corn, and many Illinois residents (possibly more than 2,000) could be employed in ethanol-related jobs. Ethanol works well in automobile engines and costs approximately the same as straight gasoline. The use of ethanol also can reduce our use of petroleum. Petroleum is being used faster than we are discovering new supplies. Most of that petroleum is imported from other countries. So, ethanol will put less pressure on petroleum supplies and help our national economy and security. Besides preventing some kinds of air pollution, ethanol could prevent water pollution. Since there would be fewer ships carrying oil to the United States, this would decrease the risk of oil spills.

Ethanol can be used alone as a fuel, or it can be blended with gasoline. All of the IEPA's vehicles use fuel that contains at least 10 percent ethanol, and the IEPA has one car that uses an all-ethanol fuel. Each bushel of corn that is processed can make two and a half gallons of ethanol. More than one billion gallons of ethanol are produced annually in the United States, more than half of that is produced in Illinois.

In our search for alternative forms of energy we have found a renewable resource in Illinois - ethanol. It is important that we understand how ethanol is produced and used, so we can decide if it can be a environmentally-safe energy source for the future.

Why Should You Plant a Tree

Whether you live in the city, in the suburbs, in a small town, or in the country, there probably is a place where you can find a tree. If you go to a park you will probably see several different types of trees, or there may be many different types of trees in your yard, school yard or neighborhood.

As we learned in Chapter 3, trees provide shade, beauty, food such as fruit and nuts, wood and paper. In addition, trees provide a home for organisms, such as insects, birds and squirrels. Trees add the soft touch of nature to our busy lives in cities, schools, and work places. Most importantly, trees clean the air. Through photosynthesis, trees take in carbon dioxide and give off oxygen.

The goal of tree planting could be described as "carbon collecting." Because trees take in carbon dioxide, tree planting helps balance the carbon dioxide we put into the atmosphere through such actions as burning coal and petroleum in power plants and automobiles. On the average, a mature tree takes in about 13 to 25 pounds of carbon dioxide each year.

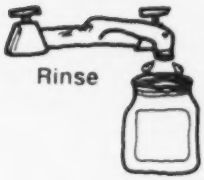
You may be surprised at the number of people who have never planted a tree. You don't have to be an expert to plant a tree *(See Handout 5D, How To Plant A Tree)*. Do some reading. There are many books available on what tree species to plant, where to plant them, and how to do it. Ask for help. Check with a local plant nursery or garden center, your county soil and water conservatio. district, or area forester with the Illinois Department of Conservation who can help you, especially to help with a class or school-wide tree planting project. Use community helpers. There are parents, retired citizens, school custodians, principals, and others who would enjoy helping you with tree planting. Now you should be ready to plant a tree!

Only a few, if any, of those trees you plant, will survive to become great oaks or maples unless some tender loving care is provided (water, weeding, and protection from animals, lawn mowers, weather, etc.). Now you can see why we ALL should plant trees!

Handout 5A

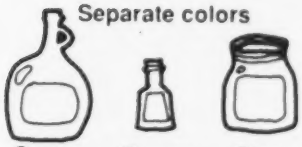
RECYCLING is as EASY

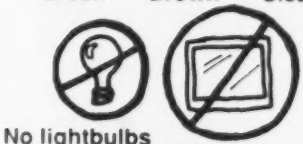
Glass bottles and jars

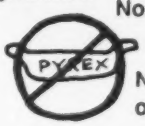


No need to remove labels

Separate colors







No dishes or glasses

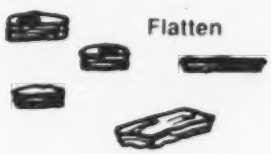
Put in bags, boxes or buckets.

Aluminum cans

Foil

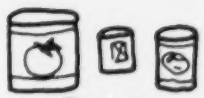
Pie plates

Magnets won't attract aluminum



Flatten

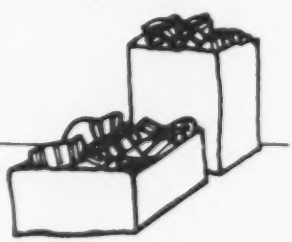
Bag or box it.



Tin cans

Flatten

Bag or box it.



as Taking Out the Garbage

Handout 5A

RECYCLING is as EASY

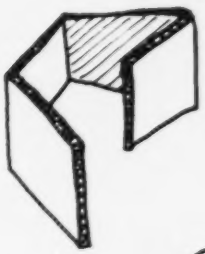
Newspaper

Bundle and tie or put in large grocery bags.

Kraft paper and corrugated cardboard

Grocery bags

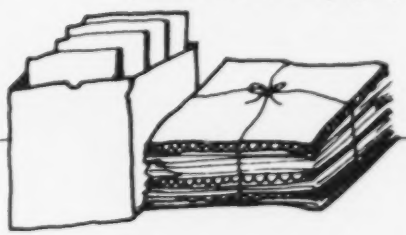
Boxes



Look for the ribbed, wavy layer. Flatten the cardboard

Brown wrapping paper

Bundle, bag or box it. (Include the kraft paper)



Motor Oil

Pour motor oil into clean leak-proof non-breakable container.

Put on the tight-fitting lid.

as Taking Out the Garbage

Handout 5B

Microorganisms of the Compost Pile

1° = First Level Consumers
2° = Second Level Consumers
3° = Third Level Consumers

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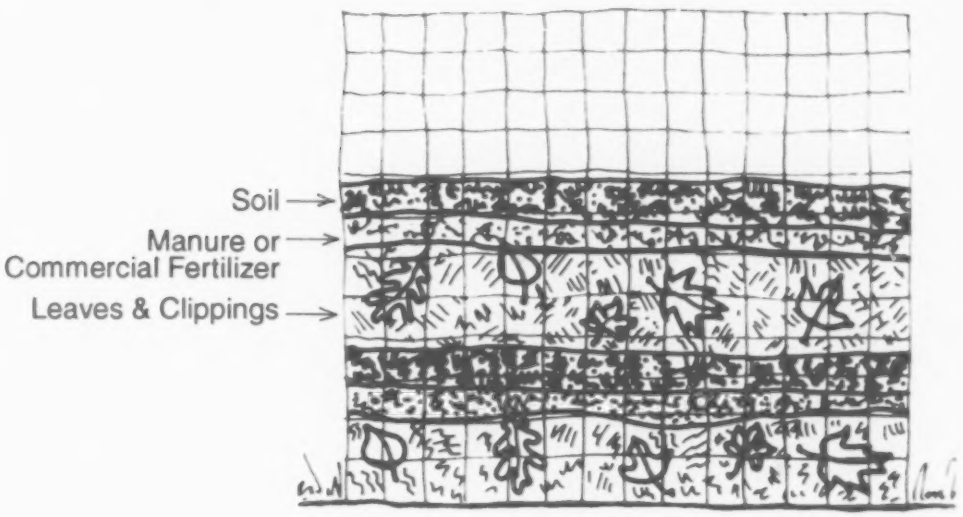
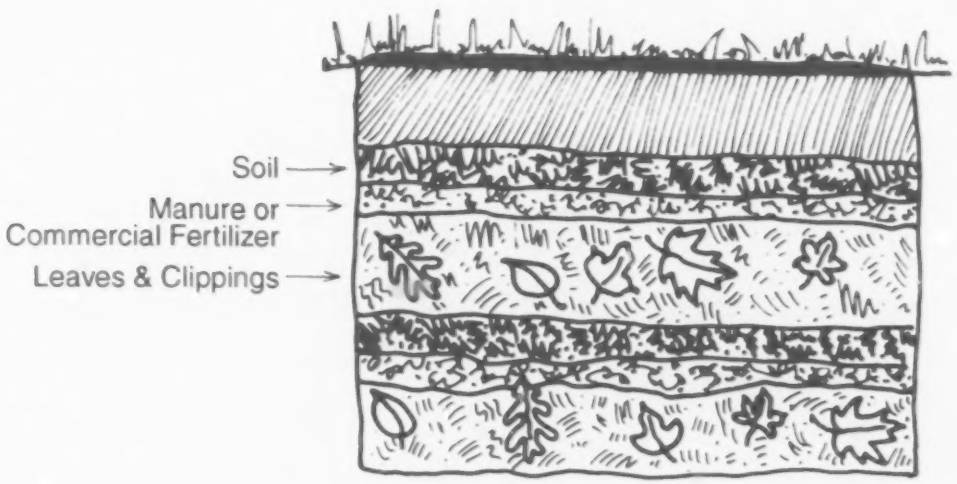
Handout 5C

Above Ground Compost Heap



Below Ground Compost Heap

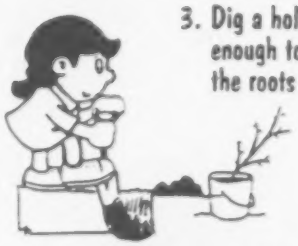


Handout 5D

How to Plant a Tree

1. Choose a proper location for your tree. Don't forget its ADULT size.

2. Keep your roots moist at all times. Dry roots die.



3. Dig a hole large enough to spread the roots apart.

4. Place the tree in the hole at the proper depth. (See below.) Gently add loose soil.

5. Add more soil and firm with foot.

6. Mulch with wood chips.

7. Water regularly. Wait for shade!

How Deep?

Too Deep. Too shallow. Just right.

Worksheet

"Middle Riddle"

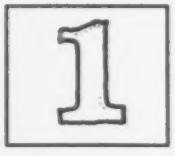
Directions: Students should first identify the ten objects below by writing the name of the object under each picture. Then the students should pick out the middle letter of each of those words and write that letter at the bottom of the page. *For example, the first object is an apple, the middle letter is "p" and the "p" is written on the #1 line at the bottom of the page.*

Now what message have the letters spelled? (Hint: Something you can do to help clean the air.)

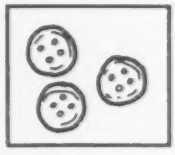
1. apple

2. _____

3. _____

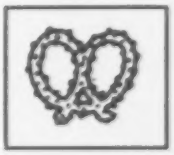


4. _____



5. _____

6. _____



7. _____

8. _____

9. _____

10. _____

P									
1	2	3	4	5	6	7	8	9	10

Correlation with Illinois State Goals for Learning

The purpose of this guide is to help schools meet or exceed the State Goals for Learning. The guide identifies how the IEPA's education packet, "We Depend on Illinois' Environment," meets state goals in specific learning areas. The guide provides a different perspective on teaching toward the State Goals for Learning while at the same time providing students with current, accurate environmental information and learning experiences. The education packet addresses all six learning areas in the State Goals for Learning.

Language Arts
In Language Arts, the goals addressed include the concepts of :

State Goal for Learning 1 - As a result of their schooling, students will be able to read, comprehend, interpret, evaluate, and use written material.

State Goal for Learning 3 - As a result of their schooling, students will be able to write standard English in a grammatical, well-organized and coherent manner for a variety of purposes.

State Goal for Learning 4 - As a result of their schooling, students will be able to use spoken language effectively in formal and informal situations to communicate ideas and information and to ask and answer questions.

Mathematics
In Mathematics, the goals addressed include the concepts of :

State Goal for Learning 1 - As a result of their schooling, students will be able to perform the computations of addition, subtraction, multiplication, and division using whole numbers, integers, fractions, and decimals.

State Goal for Learning 2 - As a result of their schooling, students will be able to understand and use ratios and percentages.

State Goal for Learning 3 - As a result of their schooling, students will be able to make and use measurements, including those of area and volume.

State Goal for Learning 6 - As a result of their schooling, students will be able to understand and use methods data collection and analysis, including tables, charts and comparisons.

State Goal for Learning 7 - As a result of their schooling, students will be able to use mathematics skills to estimate, approximate, and predict outcomes and to judge reasonableness of results.

Social Sciences
In Social Sciences, the goals addressed include the concepts of :

State Goal for Learning 1 - As a result of their schooling, students will be able to understand and analyze comparative political and economic systems, with an emphasis on the political and economical systems of the United States.

State Goal for Learning 2 - As a result of their schooling, students will be able to understand and analyze events, trends, personalities and movements shaping the history of the world, the United States and Illinois.

State Goal for Learning 4 - As a result of their schooling, students will be able to demonstrate a knowledge of world geography with emphasis on the United States.

State Goal for Learning 5 - As a result of their schooling, students will be able to apply the skills and knowledge gained in the social sciences to decision making in life situations.

Biological and Physical Sciences
In the Biological and Physical Sciences, the goals addressed include the concepts of:

State Goal for Learning 1 - As a result of their schooling, students will have a working knowledge of the concepts and basic vocabulary of biological, physical, and environmental sciences and their application to life and work in contemporary technological society.

State Goal for Learning 2 - As a result of their schooling, students will have a working knowledge of the social and environmental implications and limitations of technological development.

State Goal for Learning 3 - As a result of their schooling, students will have a working knowledge of the principles of scientific research and their application in simple research projects.

State Goal for Learning 4 - As a result of their schooling, students will have a working knowledge of the processes, techniques, methods, equipment and available technology of science.

Physical Development and Health
In Physical Development and Health, the goals addressed include the concepts of:

State Goal for Learning 3 - As a result of their schooling, students will be able to understand consumer health and safety, including environmental health.

Fine Arts
In Fine Arts, the goals addressed include the concepts of:

State Goal for Learning 3 - As a result of their schooling, students will be able to demonstrate basic skills necessary to participate in the creation and/or performance of one of the arts.

(The IEPA's education packet has been correlated with the Illinois State Goals for Learning through the assistance of the Illinois State Board of Education.)

Glossary

Acids: Any substance, typically water-soluble, that forms a salt when mixed with a base.

Adapt: To adjust to the environment, to get used to something new and different.

Algae: A group of very simple plants, without true stems or leaves, generally living in water.

Alum: A chemical used to cause small dirt particles and bacteria to cling together and settle out.

Ammonia: A colorless, water-soluble gas with an unpleasant smell.

Anemia: A condition in which the blood is lacking red blood cells.

Bacteria: Microscopic, single-celled organisms that occur in large amounts in the land, air and water.

Bioaccumulation: Amounts of pollution in a living organism, that increase as the organism grows older.

Biodegradable: Having the ability to be broken down into simpler products by microscopic plants and animals.

Biodiversity: The existence of many different types of plants and animals.

Bog: A wetland formed when low oxygen levels and soil temperatures cause incomplete decomposition and limited drainage.

Catalytic converter: Part of the exhaust system on a car that changes the form of emissions generally released at the muffler to a cleaner substance.

Chemicals: Substances that, when added to other substances, produce a change in the composition.

Chlorine: An element used for water purification.

Cholera: A bacteria-caused disease that may end in death. Symptoms include vomitting, diarrhea, cramps and collapsing.

Closed system: A system such as a spaceship, or the earth, in which energy can be exchanged with surrounding space, but matter cannot.

Clean Air Act: The federal law that requires states to start programs that will control, reduce and maintain air pollution levels.

Coagulation: A gathering together of finely suspended matter by the addition of a coagulant.

Colonize: Many of the same organisms grouping together.

Compactor: A machine that crushes and spreads trash as it is brought to a landfill.

Condensation: The cooling of water vapors which turn back to water droplets as they rise into the atmosphere and form clouds.

Contaminant: Anything that affects the purity of the air, land and water.

Copper: A metallic chemical having high electrical conductivity.

Corrosion: The process of wearing away by a chemical reaction.

Deciduous: Falling off at the end of a growing period or season (a deciduous tree's leaves fall in the autumn).

Decompose: To break down and change in both chemistry and appearance through the action of bacteria.

Deforestation: The cutting down of large groups of trees that decreases the necessary amount of oxygen released into the atmosphere.

Diversity: Having many different types of organisms together.

Ecosystem: Many different groups of plants and animals living together.

Emissions: Waste materials discharged into the air.

Environment: Everything that surrounds us; usually referring to the air, land, and water.

Erosion: The wearing away of land surfaces by the action of wind or water.

Exceedance: Occurs when pollution levels rise above acceptable levels for a specified amount of time

Evaporate: Change substances from a liquid to a gaseous state.

Floc: Small, semi-solid masses formed in a liquid when coagulants are added.

Foreign: Not natural, not appropriate.

Freshwater marsh: A wetland made of fresh water that exists year round.

Fungi: Parasitic, lower plants that lack chlorophyll, including molds, rusts, mildews, mushrooms and bacteria.

Habitat: The place where a plant or animal normally lives and grows.

Hazardous waste: Ignitable, corrosive, reactive, or toxic waste that needs special care in disposal.

Hull: The part of the boat that makes contact with the water and aids the boat in floatation.

Hydrocarbons: A mixture of gases that comes from the exhaust tailpipes of cars and trucks.

Hydrogen sulfide: A gas produced from decomposition of organic matter in marshes.

Larvae: The early form of an animal after hatching.

Lead: A toxic, metallic chemical, soft in texture and bluish-gray in color.

Litter: Trash that is scattered about or disposed of improperly.

Mercury: A toxic, metallic element used in thermometers and barometers.

Methane: A flammable type of hydrocarbon that is the product of organic matter in marshes.

Microorganisms: Any living thing that cannot be seen by the unaided eye.

Minerals: Substance, such as iron, sand or gold, that is taken from the earth.

Monitoring: Checking samples of our air, land and water for pollution levels.

Native: To be from a certain place originally.

Nitrogen: A colorless, odorless gas, that makes up almost 80% of the air we breathe.

Nutrients: Substances of nourishment that plants and animals feed on.

Open dumps: A place where garbage is disposed of in an unsanitary manner. This type of dumping is illegal.

Permit: A document giving permission to do something.

Phosphates: A salt of the chemical phosphoric acid, used in fertilizers.

Phosphorus: A type of phosphate. This element is part of the nitrogen family.

Polychlorinated Biphenyls (PCBs): A family of closely related chemicals used extensively since the 1930s. When released into the environment, they remain for long periods of time without breaking down. They are the only substances banned *by name* in environmental law.

Prairie pothole: A shallow depression that holds water, generally in the springtime or after a lot of precipitation, and not attached to any major river source.

Precipitation: The falling of rain, snow, sleet, or hail.

Prevent: To keep or stop an event or effect from occurring.

Regulate: The primary job of the IEPA; enforcing laws that control and monitor pollution levels within the state.

Reservoir: Large water holding pool, such as a lake or manmade tank.

Resources: Air, water, soil, trees, plants, minerals, wildlife, and other things that make up the natural wealth of our earth.

Respiratory system: A body's system for breathing, including the nose, throat and lungs.

Runoff: Water from rain, melting snow, or irrigation that flows over the ground and returns to lakes or streams, sometimes carrying with it pollutants picked up from the air or land.

Saturated: To be full of some liquid.

Sediment: Soil, sand, and other minerals from the land.

Septic tank: The tank in which sewage is disposed.

Sewage: The organic waste and wastewater that comes from homes and businesses.

Soot: Black particles, usually carbon, produced by burning fuels.

Spawning: The reproduction of fish and other aquatic animals, that produce eggs.

Stratosphere: The layer of the atmosphere which extends from seven to 90 miles above the earth's surface.

Swamp: A wetland where the soil is saturated with water and trees are dominant over vegetation.

Threatened or endangered species: Life forms that are close to being non-existent on our planet.

Topsoil: The most productive layer of dirt; the part that is plowed for farming.

Toxic: Poisonous

Transpiration: The process of water passing from the roots of a plant to its leaves.

Treatment: Use of chemicals or other processes to make wastewater less toxic.

Water-cycle: The process by which water, affected by gravity and the heat of the sun, changes from a liquid to a vapor or solid, and finally, back to a liquid.

Watershed: The land that drains water into a larger body of water.

Water vapor: Water that has been changed to gaseous state; one stage of the water cycle.

Zinc: A chemical which, in various forms, is used for roofing, skin ointment and coating processes.

Worksheet Answers

Chapter 1

Fill-in-the-Blanks

1. Pollution
2. closed system
3. plastics
4. biodegradable
5. groundwater
6. environment

Short Answer

1. Litter, cars, mines, factories, materials dumped in water, chemicals sprayed in the air, etc.
2. We breathe the same air and drink the same water as King Tut.
3. It goes through the water cycle (rain or snow, falls on land or water, some evaporates, forms clouds, cycle starts over again).
4. Without photosynthesis, no oxygen would be produced, and no life could exist.

Chapter 2

Across

1. trees
3. precipitation
5. landfill
7. soil
9. water
10. oxygen

Down

2. rivers
4. toxic
6. pollution
8. ozone

Chapter 3

1. boaters
2. swimmers
3. anglers
4. industries
5. local water suppliers
6. cultured pearl industry
7. native mussels

Chapter 4

G N I P M U D N E P O
N R Z V E H I C L E S
I S O T S E B S A Q P
L G S U P E R F U N D
C V S D N A L T E W O
Y U L A N D F I L L S
C J A K S B W L W A F
E F N M R E T A W A L
R T D H Q I Y W T P L
I A I V K C P S B E N
A L E A V E S Z T I R

Chapter 5

1. apple
2. balloon
3. bat
4. one
5. buttons
6. hat
7. pretzel
8. arrow
9. bee
10. key

PLANT A TREE
1 2 3 4 5 6 7 8 9 10

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We Depend on
Illinois' Environment - Activity Book

Fifth Grade
(Materials may be duplicated for classroom/activity use)

Office of Public Information

Illinois Environmental Protection Agency
2200 Churchill Road, P.O. Box 19276
Springfield, IL 62794-9276
217/782-3397

1994

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Air Activity

Air, Air Everywhere

Objective - Students will discover that air is everywhere and that air is vital to all forms of life.

Method - Students use science skills to investigate the presence of air (oxygen) in water.

Background - Clean air is a mixture of different gases which have no smell. Air is mostly made up of nitrogen and oxygen, but with small amounts of water vapor, argon, carbon dioxide, neon, helium, and hydrogen. Clean air is very important. Take away your supply of air and you would be dead in minutes. All life needs air. No new air is ever added to the earth. Instead, green plants clean "used" air. To grow, plants use sunlight and the carbon dioxide that people and other animals breathe out, and they produce the oxygen we need to breathe in. Without green plants the oxygen in the air would be used up.

Water also contains air. A molecule of water contains two atoms of hydrogen and one atom of oxygen. Water, because it also contains air, has properties that makes it useful to living things such as fish.

Materials -
- Diagram of parts of the air (*Handout 2A* from the education manual)
- Diagram of how plants use air (See photosynthesis diagram on p. 29 of activity book.)
- Large bowl
- Water
- Cups
- Sponges or paper towels
- Food coloring

Procedure -

1. Discuss what air is and why it is important. Use the diagram of the parts of the air and explain how plants produce the oxygen in the air.

2. Explain that air is found everywhere. Ask the students if they think that there is air in water.

3. Fill a large bowl with water. Color the water with a little food coloring. Stuff a sponge or paper towel in the bottom of a cup. Turn the cup upside down and push it straight down into the bowl of water. Lift the glass out of the water. Turn the cup right side up and take out the towel or sponge. It is dry!

4. Show and explain why the towel or sponge is dry. Put the cup in the water again. Look at the glass through the water and observe that the water does not go in. The water cannot go in the cup because it is filled with air. Tip the glass a little and let a bubble of air out. When the air goes out, there is an empty space in the cup for the water to go in. You can see this happening (The food coloring helps to see this process. You can add food coloring to the bowl of water before you start the experiment with the cup). Tip the cup until all of the air goes out, and it is full of water.

5. Now remove the cup. The towel or sponge is soaking wet. When the glass was full of air, there was no room for water. When the air went out, the water went in.

6. A cup should have been filled with cold water a half hour or more before the experiment. Another cup will be filled with water with the students present. Ask the students to observe the two cups and ask the students how the water in each of the cups looks different. The cup that was filled earlier will have little bubbles on the inside surface. These are tiny bubbles of air. The air came out of the water. The water contained dissolved air and as the water warmed, some of the air escaped. The second cup will not have bubbles on the inside surface.

7. Conclude the demonstration with a discussion concerning how the students can help protect the air.

Water Activity

How Wet is Our Planet?

Objective - Students will be able to describe the amount and distribution of water on the earth in oceans, rivers, lakes, groundwater, icecaps/glaciers, and the atmosphere and learn about the importance of responsible water use.

Method - Students calculate the quantity of water on the earth.

Background - The earth has been called the water planet. Between two-thirds and three-fourths of its surface is water. The earth's water can be seen in flowing rivers, ponds, lakes, oceans, locked in the northern and southern icecaps and glaciers, and drifting through the air as clouds. Water that has seeped into the earth's crust (groundwater) is more difficult to see, yet all these forms of water are part of a dynamic interrelated flow that we call the water cycle. Each of the segments of the water cycle shares a portion of the total amount of water on the planet.

Students tend to think of the water on the planet as being limitless, and yet simple calculations demonstrate the fact that the amount of water is limited. Scientists believe that all the water that we will ever have is on the earth right now. Whatever amount is available to humans, wildlife, and plants depends largely on how its quality is maintained. Human beings have a responsibility to conserve water, use it wisely, and protect its quality.

Materials -
World globe or map
Diagram of the water cycle
1.5 gallon bucket
Measuring cups
Measuring spoons
Eyedropper
Food coloring
Water

Procedure -

1. Using a globe or map of the earth and a diagram of the water cycle, begin a discussion of how much water is present. Ask the students to comment on why the earth is called "the water planet." Provide the students with the following statistics:

Water on Earth

Oceans	97%
Icecaps/glaciers	2%
Groundwater	
Freshwater lakes	
Inland seas/salt lakes	
Atmosphere	
Rivers/streams	1%
TOTAL	100%

2. Now show the students 1.5 gallons of water in a bucket. Tell them how much is there. Have the students imagine that the 1.5 gallons is all of the water on earth. Provide the students, with the following quantity: 1.5 gallons = 320 tablespoons. Show the students, or better, have the students guess the volumes of each of the water types on earth in relation to the 1.5 gallons. Display the measuring instruments (cups, spoons, eyedropper) for the students to use. For demonstrating how much water is on earth, use the following values: *Be sure to start with the smallest quantities first (rivers/streams) and work your way to the largest quantities (oceans).*

Water on Earth

Oceans	311 TB
Icecaps/glaciers	6 TB
Groundwater	2 TB
Freshwater lakes	1/8 Tsp
Inland seas/salt lakes	1/8 Tsp
Atmosphere	2 Drops
Rivers/streams	1 Drop
TOTAL	320 TB

3. Show the students or have the students guess how much of that water (fresh water vs. salt water) is available or suitable to drink:
Groundwater+Freshwater lakes+Rivers/Streams= 2TB+1/8 Tsp+1Drop
(Icecaps/glaciers are fresh water, but are not readily available for drinking water.)

4. Consider the fragile nature of the freshwaters, wetlands, and oceans of our planet. Discuss how all species (including humans) depend upon this small percentage of water for their survival. Use a drop of food coloring in the container of drinking water to show how a little pollution can affect the water. Close by emphasizing the importance of keeping the earth's waters clean and healthy and, when we do use water, use it wisely and responsibly.

Land Activity

The History of Garbage

(Adapted from the "Throwaway Three")

Objective - *"The History of Garbage"* is a skit in rhyme written for 14 characters, but more characters can be added so that a different person can be used for each of the rhymes, thus involving a larger number of students.

Method - Students will use language arts, fine arts, and social studies skills to present and discuss a skit.

Background - Each part has three notations beside it. The first is the character (Monkey, Cave Dweller, etc.). The second is that character's date in history. Make signs for each of these dates and have one person hold up the appropriate date sign at the appropriate time in the skit. The third notation describes the props. This includes both the costume for the person in history and the articles thrown away.

Procedure - The central idea is that as the skit progresses, each person throws more trash on the pile in the middle of the room so that a high stack is created. The skit suggests that one way to solve the problem is to recycle. A discussion of ways to solve the problem of too much garbage and trash will follow the performance.

THE HISTORY OF GARBAGE
Person 1
This is the tale
Of Man and his Garbage throughout his-to-ry:
Now they're very nice people, just like you and me,
Who all have a problem, as you will soon see -
What shall they do with their garbage and trash.

All
Why, throw it! Or bury it! Or burn it to ash!

Person 2
90, 000 BC
(Monkey)
I represent people when we lived in a tree.
I get rid of my garbage so easily!
It's a snap! It's no problem - to me, or to him.
We just let go, plop! Down through the limbs!

(PROPS)
Monkey Masks

Banana Peel
Orange Peel

Person 3
50, 000 BC
(Cave dweller)
I am a cave dweller who lives on the ground.
What do I do with old stuff all around?
Why, burn it, like meat; burn it up in the fire;
Or bury it like bones, in the muck and the mire.

(PROPS)
Skins

All
Yes, throw it, or bury it, or burn it to ash!
That's how we always get rid of our trash!

Person 4
200 BC
(Roman)
I am a Roman who lives in the town.
Our laws won't allow me to just throw it down.
I have to drag it away for a mile
And then I can dump it, forget it and smile!

(PROPS)
Roman Helmet
Bag of Trash

Person 5
1200 AD
(Briton)
I am a Briton, wary and quick;
Down on our street it can get pretty thick.
When housewives up there want to pitch out their goo,
They just heave it out there and yell: "Gardy-loo!"
(Person 5 stands on chair and yells "Gardy-Loo!")
It will stay there and stay there until the next rain,
Or until our fair London should burn down again.

(PROPS)
Sack of trash

All
Oh, what do we do with our garbage and trash:
We throw it, or bury it, or burn it to ash!

Person 6
1630
(Settler)
I am settler. I came without much,
Oh, a rifle, an axe, some few tools and such.
But everything else I must make with my hands.
So I don't throw out much - I use all I can.
Cloth scraps become quilts; I reuse my bent nails.
It will be a long time 'fore the next trade ship sails.

(PROPS)
Pilgrim Hat
Quilt

Person 7
1700
(Colonist)
I am a colonist; now life's not so tough.
We have trade between cities that brings lots of stuff
And some things are made by our townfolk today,
I could buy a new harness, throw this old one away.
We have pigs and hogs running loose in our street,
If I toss it out there, they'll eat it up neat!
Or I might bury it right over there.
Or I might burn it; nobody would care.
You see; the New Wodd is the same as the Old!
We trashmakers come from a time-honored mold.

(PROPS)
Coonskin Hat
Leather Harness or Belts

All
What are we still doing with garbage and trash?
You guessed it! Throw it or bury it or burn it to ash!

Person 8
1890
(Industrialist)
I'm the industrial person and new on the scene,
I mass-produce goods with my trusty machine.

This sweater, handmade, took a week in days of yore,
But now in one hour, I can make fourty-four.
I make things so cheaply, you can now afford two,
And throw out twice as much trash as you need to do.

(PROPS)
Engineer's Cap
3 sweaters
(One handmade; two machine-made)

Person 9
1950
(Scientist)
I am the scientific person in the new post-war age.
We've learnd a few tricks while the war shortage raged.
When we couldn't get natural stuff to process
We invented synthetics to replace the rest.

(PROP)
Lab coat

Person 8
(Industrialist)
Rayons and nylons, acrylics and plastics
For furniture and clothing and even elastics;
Forget your old woolens and silks and your cotton;
Real wooden toys and washboards are forgotten.

(PROPS)
Nylon stockings
Plastic Bags & Containers

Person 9
(Scientist)
Our new stuff will last till forever, you see
Even when it's worn out to you and to me.
Permanent pressed, pre-sized and pre-shrunk
When dingy and old, it's still permanent "junk"
(Person 9 yells, "Junk!")

(PROP)
Perma-Pressed Shirt

Person 10
(Industrialist)
We make instant menus that come in a pack.
You just boil the food in its own plastic sack.
Or our TV dinner in its tinfoil tray
It's quick; you don't wash it; just throw it away!

(PROPS)
Plastic Bag
TV dinner

Person 11
(Scientist)
We make lots of TVs and clothes dryers, too.
Don't ask for a trade-in; you're kidding, aren't you?

(PROP)
Broken Small Appliance

Person 10
(Industrialist)
Our new cars all change with each model year
Don't try to repair them, the cost's much too dear.
Besides, we don't bother to make last year's parts
For Skylarks or Novas or Cougars or Darts.

(PROP)
Toy car

Person 11
(Scientist)
It's the New Thing, the NEW that America craves.
So out, out with the old stuff, away to its graves.

Person 12
(Industrialist)
So what if there're more of us buying more goods?
So what if they won't rot away as they should?

Person 13
1818
(Indian)
Now wait just a minute! You cannot fail
To include me in your historic trash tale.
We Indians lived simply, on prairies, in woods,

We made no high trash piles, nor mass-produced goods.
Let me be your critic, show you where you stand;
And tell you just how you're defiling our land.
Your newfangled goods will not rot away.
When you throw them all down they remain where they lay
Then you say you will bury them deep in the ground:
All your urban trash will make quite a mound!
So then you would burn it, in smoldering masses
And fill up our air with smoke, deadly gases!
Oh, all of your answers have faults everywhere:
You'll either ruin the water, the land or the air.
What's more your resources - your lumber, your ore,
Get smaller each year than the year just before.
And what's more - this old earth's not making any more.

(PROP)
Indian Headband

Person 12
(Industrialist)
You're right. Our resources are shrinking away
While our garbage problem grows bigger each day.
We're always converting resources to refuse
Instead of recycling them for reuse!

(Throw out old blanket and cola bottle)

Person 14
(Scientist)
Oh stop it! Don't drop it! We'll think of a way
To make food for cows that's much better than hay.
Don't burn it, return it - we'll make something new,
A vase for your mother, a spyglass for you.
(Flower in bottle for vase, flower out, bottle held up to eye for spyglass.)
Don't bury it, carry it - back to the mill.
We'll make a new blanket to ward off the chill.

(Pick Up Old Blanket and Wrap Around Shoulders)

Person 12
(Industrialist)
It's time we progress past the Disposal Age
And make recycling the popular rage!
We'll have to give up old solutions for trash
And all realize that its pure balderdash - to just

All
Throw it, or bury it, or burn it to ash!

DISCUSSION
The skit shows the children that people have historically gotten rid of solid waste successfully by throwing it out, burying it, or burning it. But none of these methods solves modern urban garbage problems. The discussion should attempt to reinforce this concept. One way this can be done is to discuss the characters in the skit: how they disposed of their garbage or trash and why their method of doing so was either satisfactory or not satisfactory.

Monkey: Threw it down.
No problem developed because no large concentration of monkeys existed. The garbage disintegrated.

Cave dweller: Threw it, burned it, buried it.
These acts still did not cause a problem for the same reasons.

Roman: Threw it.
Tossing out garbage began to be a problem because of the many people who lived in cities, but it was easily solved by taking thg garbage out of the city.

Briton: Threw it.
A problem grew because more and more people moved to the cities, thus producing more trash than they could get rid of in the city.

Settler: Had virtually no garbage.

Colonist: Threw it, burned it, buried it.
Greater trade resulted when people did not use goods until they wore them out, but then more things to be discarded began to accumulate.

Industrialists:
With a greater concentration of people in cities than ever before and more buying because machine-made goods were cheaper, much more was thrown out.

Scientists:
The big change to synthetics plus the use of enormous amounts of natural resources are causing tremendous problems.

We can't throw "away" our trash. There simply is no such place anymore. Care is always required to prevent our trash from having bad effects on our lives and the environment.

We can't bury it all. There are not enough places are available. Besides, the modern synthetics do not decompose when buried.
We can't burn it all. Some of the synthetic goods simply won't burn. Most of the burning requires expensive and often elaborate controls to prevent air pollution. And there is always ash or something left over which must be buried.

We are literally running out of some natural resources so that any form of disposal of certain goods is self-defeating, and there is a very important need to reduce, reuse, and recycle.

Air Activity

Sources of Air Pollution

Objective - Students will discover that air pollution is caused by many things and everyone contributes to air pollution, and they will learn that we all have a responsibility to control this pollution.

Method - Students will use language arts skills to discuss and list several different things that cause air pollution. Then they will use fine art skills to draw a map that identifies various sources of air pollution in their community.

Background - There are many different types of air pollution. Seven major air pollutants are found in Illinois. They are: asbestos, carbon monoxide, lead, nitrogen oxides, ozone, particulates, and sulfur dioxide. Most air pollution comes from the burning of fossil fuels that produces energy to run factories to manufacture the things we use everyday. Coal and gas burning power plants pollute the air in the process of making electricity. The more we use electrical appliances, the more electricity these plants have to produce, and the more we are contributing to air pollution. The following is a brief summary of the seven major air pollutants in Illinois.

Asbestos - A mineral found in nature that was commonly used in building materials. It is typically found in older buildings. When asbestos fibers are released into the air they can be inhaled or swallowed. Exposure to asbestos can cause health problems.

Carbon Monoxide - A colorless, odorless deadly gas that comes mainly from automobiles. When the carbon in gasoline doesn't completely burn, the left over carbon combines with oxygen and turns into carbon monoxide.

Sulfur dioxide - A gas released when coal and oil are burned in home furnaces, industrial furnaces, and in power plants. Coal and oil contain sulfur. As these fuels burn, the sulfur combines with oxygen and turns into sulfur dioxide.

Nitrogen Oxides - This is produced when burning fuels at high temperatures. About half of the nitrogen oxides in the air are produced by cars, trucks, buses and airplanes. The other half comes from industrial and power plant furnaces.

Lead - This used to be added to almost all gasoline to improve engine performance. However, because lead particles escape through the exhaust pipe and pollute the air as an engine runs, the use of leaded gasoline has been sharply reduced. New cars are not allowed to use leaded fuels. Lead used to be added to paint. It was discovered that when children were exposed to lead paint it could cause health problems, so it is no longer used in paint. Some old buildings may have walls that are covered with lead paint.

Particulates - These are small particles of dust, metal or other material that can float in the air. Particulates come from industries such as coal burning power plants, steel mills and mining operations and from natural sources such as forest fires and volcanos. Particles also come from burning leaves in the fall.

Ozone - This is produced when fossil fuels are burned and combine with air in the sunlight. These chemicals come from motor vehicles, gas stations, dry cleaners, household products and appliances - such as fireplaces, lawn mowers, barbecues, and jet engines, and industrial operations.

Procedure -

1. Discuss with students the seven types of air pollution found in Illinois.

2. Ask the students to draw a map of their town and to identify sources of the seven air pollutants that are found in Illinois. Give the students examples of sources to look for in their town to put on their map such as power plants, automobiles, airports, factories, old buildings, homes, trees, mines, etc.

3. Students should bring their maps to class and discuss the sources of air pollution that they have discovered. Some students may have found sources that other students hadn't considered.

4. What can be done to stop air pollution? Have the students brainstorm for answers. Can each student come up with one solution to reduce air pollution for one of the sources on their map? Be creative with your solutions.

Water Activity

Water Critters

Objective - Students will be able to identify several aquatic organisms which are called macroinvertebrates ("water critters") and assess the environmental quality of a stream or lake based on the presence of a diversity of organisms.

Method - Students investigate a stream or lake using sampling techniques and science skills.

Background - Water with a rich and varied range of aquatic creatures is usually a healthy environment, whereas water with just a few different species usually indicates pollution and unhealthy conditions. Healthy conditions indicate an environment supportive of life. Pollution generally reduces the quality of the environment and in turn, the diversity of life forms. In some cases, the actual amount of living material will increase due to pollution, but the diversity inevitably goes down. The major purposes of this activity are to present an example of a sampling procedure which is used to detect pollution in surface waters and for students to recognize the environmental quality of rivers, streams, lakes, and ponds by the presence or absence of macroinvertebrates ("water critters.")

Materials - Lake or stream poster (illustrate life in a lake or stream)
Sieve (screen-like device used to snare organisms, allows water to pass through)
Tweezers (used to hand-pick organisms from habitat)
D-frame net, kick-seine net, other type of net (device used to capture organisms)
Macroinvertebrate identification specimens (preserved specimens of "water critters")
Dissecting scopes or hand lens (used for magnification of macroinvertebrates)
Macroinvertebrate keys (aid in identification of organisms)
White trays or pans (used to hold "water critters" for observation)

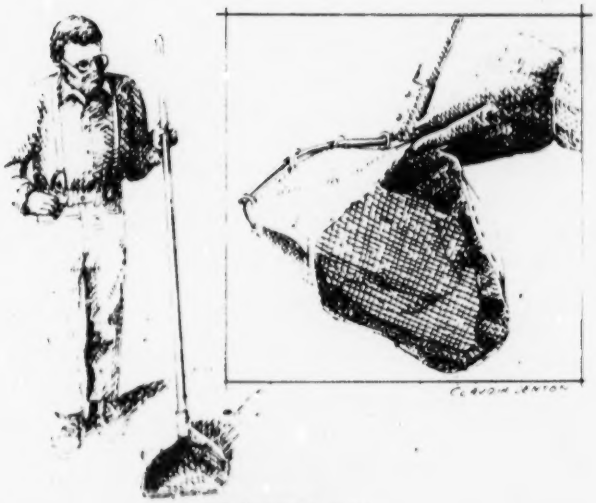
Sieve

Procedure -

1. Select a sampling site. Try to find a small, fairly shallow, slow-moving stream or lake.

2. Brief the students on the ways to minimize the potential for damaging habitat and encourage care in their collecting techniques.

3. Start by observing the water. Look for signs of life. Use the lake or stream poster.



D-frame net

4. Demonstrate use of the d-frame net and/or kick-seine net. Pick a sampling area and vigorously kick the stream or lake bottom to dislodge any creatures, while at the same time sweeping the area with the d-frame net. The kick-seine net should be stretched across the stream and the bottom edge should lie firmly against the stream bed. The nets should be held downstream of the sampling area. The macroinvertebrates are trapped in the net and removed with tweezers. Organisms will be placed in trays for viewing.

Seine

5. Macroinvertebrate samples also will be hand-picked by walking along the edge of the lake or stream and removing creatures from rocks, twigs, and vegetation. By using the sieve, organisms can be snared while filtering out unwanted water.

6. The macroinvertebrate identification demonstration will use dissecting scopes or hand lens for magnification purposes. Identify these organisms by using the attached *Field Identification Reference Sheet* and explain their role in pollution detection. If most of the macroinvertebrates you find belong to Group I, then the water body has excellent water quality. On the other hand, if you only find Group IV organisms, you are studying a polluted water body. Most of the lakes and streams you find will fall into the middle categories of Group II and Group III.

7. Students should draw the water critters they identify on the worksheet that accompanies this activity. Ask the students to draw the natural setting in which they found the organism(s) and record how many they found. Once these observations are made carefully return the animals to their natural habitat.

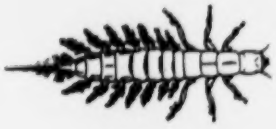
8. If you are unable to leave your school ground to visit a stream, lake, or pond, bring a sample of the water to your classroom. Be sure to collect the water sample (you can use a five-gallon bucket) within an hour or two of doing the experiment so that the organisms will have sufficient oxygen to survive. Bring a plastic wading pool to your classroom, put a white plastic sheet on the bottom of the pool, and pour the water in the pool. You can then collect and identify organisms.

(Further explanation of macroinvertebrate use and identification can be found in an Illinois Department of Energy and Natural Resources publication entitled, Citizens Stream Monitoring : A Manual for Illinois. The publication is free and available by calling 1-800-252-8955.)

Field Identification Reference Sheet

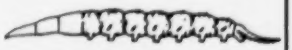
Group I - These organisms are generally considered to be intolerant to pollution

Stonefly Nymph



Adlerfly Larvae

Dobsonfly Larvae



Snipe Fly Larvae

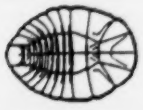
Group II - These organisms are generally considered to be moderately intolerant to pollution

Caddisfly Larvae

Mayfly Nymph

Adult Riffle Beetle

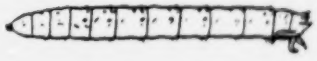
Riffle Beetle Larvae



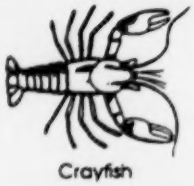
Water Penny Beetle Larvae

Damselfly Nymph

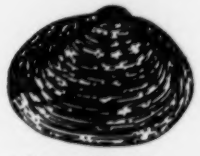
Dragonfly Nymph



Crane Fly Larvae



Crayfish



Clams/Mussels

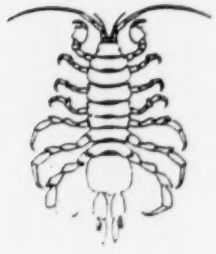
Group III - These organisms are generally considered to be fairly tolerant to pollution

Black Fly Larvae

Scud

Right-Handed/Other Snails

Midge Larvae

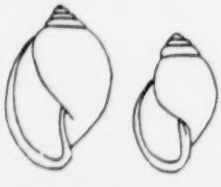


Sowbug

Group IV - These organisms are generally considered to be very tolerant to pollution

Aquatic Worms

Leech



Pouch/Left-Handed Snails

Blood Worm Midge Larvae

WORKSHEET

Where organism was found	Sketch of organism	Location	Number found

Land Activity

Making a Mini-Landfill

Objective - Students will observe what happens to materials when placed in a landfill and decide whether they should be disposed of in a different way.

Method - Students use science skills to make a mini-landfill.

Background - Open garbage dumps have been improved by turning them into sanitary landfills. Today's landfills are constructed to contain wastes and to keep them from the surrounding soil and water. An example of a safeguard is a protective liner at the bottom of a landfill to prevent filtration into the soil or groundwater. These liners may be made of clay or materials such as plastic. When clay is used, the layer may be as much as 10 feet thick.

Each day, landfill operators must handle truckloads of trash. Once trash has been unloaded at the landfill, it is spread and crushed by a bulldozer or compactor. As each day ends, the waste is covered with a layer of soil to prevent foul odors and to keep insects and rodents away from the garbage.

When a landfill can no longer hold any more garbage, it is sealed and covered with a cap of clay and dirt. Landfills may be turned into parks, gardens, golf courses, playgrounds, or even ski and sledding areas.

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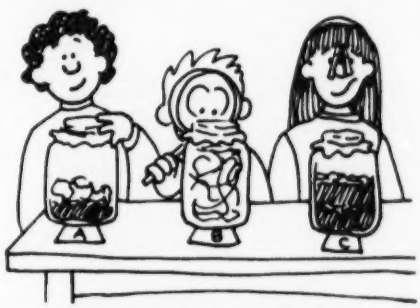
Materials -
- A large clear glass jar
- Soil
- A piece of fruit or vegetable
- Small piece of hard plastic
- Piece of paper
- Piece of aluminum
- Plastic wrap
- Masking tape



Making a Mini-Landfill

Procedure -

1. Place plastic wrap (as a liner) inside the glass jar and use masking tape if necessary to hold it in place.

2. Place soil on top of the plastic wrap in the bottom of the jar.

3. On top of the soil, place the piece of fruit and piece of hard plastic. Also add a small piece of aluminum foil and a small piece of paper.

4. Add more soil on top of these items.

5. Put the container in a warm place and keep soil damp.

6. After one week and again after two weeks, check to see what has happened to the waste in your landfill.

7. Discuss: Does the fruit look different than it did when you buried it?

Does the plastic look different?

Some things break apart, or decompose, in the environment. Other things persist, or last for a long time. Which do you think is more harmful for the environment?

What are some of the things you throw away at home that are buried in your local landfill?

How long would you guess it takes for these items to decompose and turn to dust? (See handout on page 28: *How long does it take our garbage to decompose and turn to dust?*)

Handout

How long does it take our garbage to decompose and turn to dust?

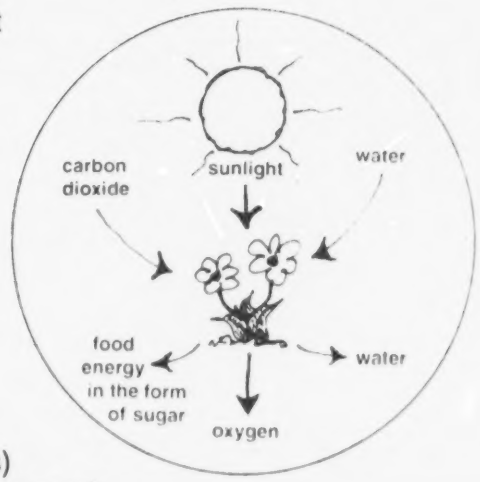
Air Activity

Trees and the Air

Objective - Students will learn what a tree is, how it lives and grows, and how trees are important to all life through the production of oxygen and the removal of pollutants from the air.

Method - Students will use fine arts, science and observation skills to act out the parts of a tree.

Background - A tree is the largest of the woody plants. Trees can be small like a redbud (about 12 feet) or large like a sequoia (over 200 feet). Trees are factories that produce food for themselves and other organisms and produce oxygen through a process called photosynthesis. This is how photosynthesis works: Like all living things, plants breathe. Plants (such as trees) take in air through pores (tiny holes) in their leaves. To make food, leaves need water and mineral salts from the soil. Leaves also need sunshine and a gas, carbon dioxide, from the air. The green substance in leaves called chlorophyll uses sunshine to turn water, mineral salts, and carbon dioxide into food for the plant. Oxygen is one of the waste materials plants release when they make their food. The oxygen goes into the air. Without green plants such as trees, the oxygen in the air would be used up and organisms such as humans could not live. When leaves absorb carbon dioxide, they are also helping to clean the air, because carbon dioxide is a harmful gas.



Materials - Diagram of a tree (how it works),
Cards (each with the name of a part of a tree)
Hat or other container

Procedure -

1. Discuss with the students what a tree is, why they are important, and how a tree works (use the diagram of a tree).

2. Students should be in a large, open area. Explain to them that they will be building a tree. Each student will function as a part of a tree.

3. Put the tree part cards (see #5 below) in a hat or other container. Each student will pick a part to play by reaching into the hat and pulling out a card.

4. Now start to build the tree. Start building the tree from the inside, out. Explain to students what each part does and have the students practice their parts before adding the next layer to the tree.

5. Heartwood (1) - Inactive, gives the tree strength so it stands straight and tall. *Student flexes muscles for heartwood.*

Sapwood (2) - Carries sap from the roots to the leaves. *Ring of sapwoods stand around the heartwood and reach down and up.*

Cambium (4) - A very thin layer where the tree grows new wood and bark cells. *A cambium ring will be added outside the sapwood. Students join hands and chant, "grow, grow, grow."*

Inner Bark (5) - The inner bark or phloem carries sap from the leaves to the roots. *Students form a ring outside of the cambium by joining hands and reaching up and down.*

Outer Bark (6) - A tough layer which is the outer covering of the tree that we see. Protection for the tree from wind, rain, cold, insects, animals, and loss of water. *The outer bark forms around the inner bark and faces outward. Students hold up fists and imitate punching.*

Lateral Roots (2) - Roots that reach outward for water and nutrients near the surface of the ground. *Students that act as lateral roots will lie on their backs; their feet will face the heartwood. Students will make a slurping sound.*

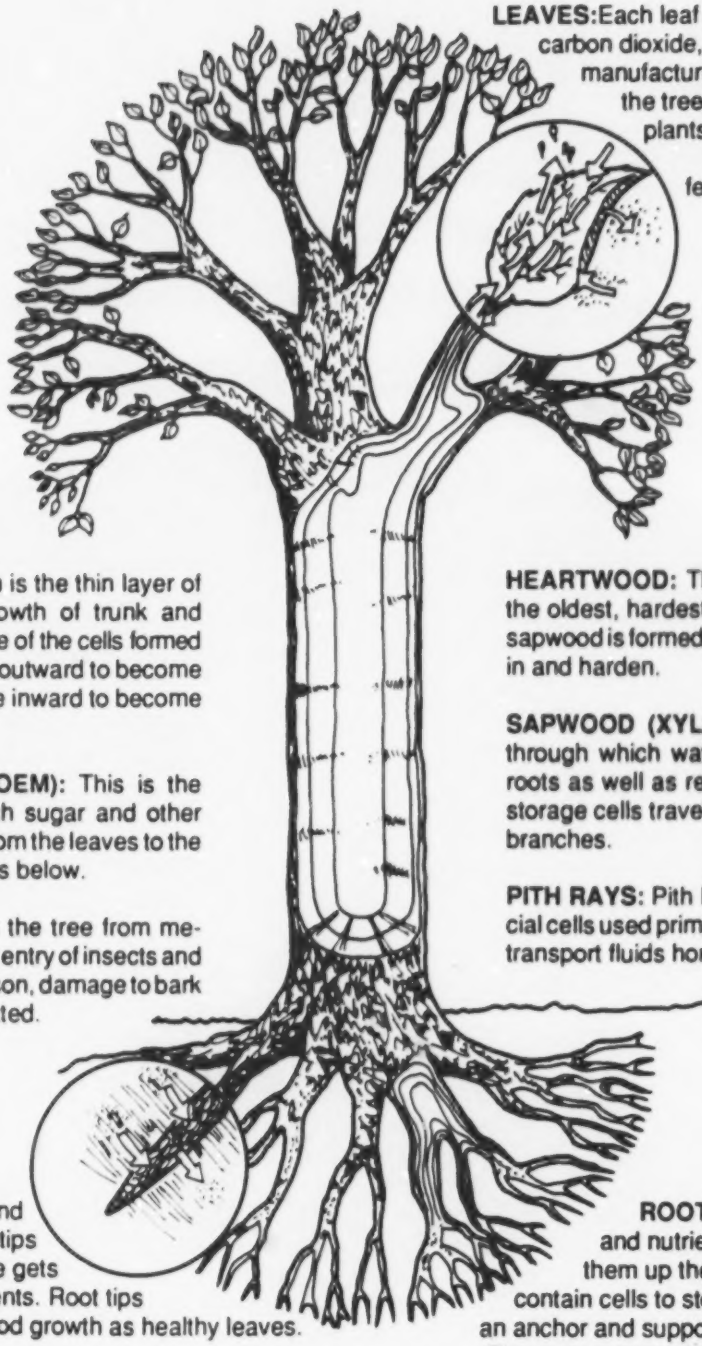
Taproot (1) - The large vertical root or anchor of the tree that reaches down deep into the ground for water and nutrients. *The taproot will sit crossed leg in front of the heartwood and make slurping sounds.*

6. After the students practice their parts (the number of students for each part will vary with group size), have the students go through the motions together (Explain to them that a tree can only live if all of its parts work together.).

7. Lead a discussion concerning the many valuable uses of trees (shade, a place to climb and play, food and homes for organisms). Ask the students to name some of the many gifts that humans get from trees (nuts, fruits, syrup, gum, rubber, cocoa, wood for construction and furniture, paper, etc.).

Handout

Parts of the Tree



LEAVES: Each leaf is a food factory that uses carbon dioxide, water and solar energy to manufacture sugar, the basic food for the tree. Photosynthesis by green plants is the basic, fundamental link in the food chain that feeds all plants and animals in the world.

CAMBIUM: Cambium is the thin layer of cells in which all growth of trunk and branches occurs. Some of the cells formed in the cambium move outward to become bark, and others move inward to become sapwood.

INNER BARK (PHLOEM): This is the pipeline through which sugar and other materials flow down from the leaves to the roots and storage cells below.

BARK: Bark protects the tree from mechanical injury and the entry of insects and diseases. For this reason, damage to bark should always be treated.

HEARTWOOD: This supports the tree. It is the oldest, hardest wood in the tree. As new sapwood is formed, the older sapwood cells fill in and harden.

SAPWOOD (XYLEM): This is the pipeline through which water and nutrients from the roots as well as reserve food from the tree's storage cells travel upward to the leaves and branches.

PITH RAYS: Pith Rays are the areas of special cells used primarily for food storage and to transport fluids horizontally.

ROOT TIPS: Roots end in millions of tiny root tips through which the tree gets all its water and nutrients. Root tips are as essential to good growth as healthy leaves.

ROOTS: The roots collect water and nutrients from the soil and send them up the trunk to the leaves. They contain cells to store sugars and also act as an anchor and support to hold the tree upright. The root system of a tree is usually longer and more branched than its top.

Air Activity

Catching Air Particles

Objective - Students will discover that there are particles of dust and other materials in the air that can cause pollution. Students will try to catch these air particles.

Methods - Students will use observation, analysis, and science skills to catch air particles.

Background - Solid particles of soot and dust are sometimes in the air we breathe. They are called particulate matter. These particles come from burning fuel and leaves, construction projects, harvesting corn, soybeans, etc., and from natural sources such as volcanoes. Eventually, these particles can be inhaled by people and other animals, fall into the water, or settle on the surface of buildings or cars as dust or grime.

Materials -

Flashlight or slide projector
White paper plates
Petroleum jelly
Tape or string
Microscope slides
Microscope

Procedure -

1. In a darkened room, turn on the beam of a flashlight or slide projector. Observe the specks of dust floating in the light. These specks are particulate matter. Where do the particles come from? (chalkboard, dirt brought in on shoes from the playground, etc.)

2. Students should be divided into groups. Each group will receive a paper plate. Cover each paper plate with petroleum jelly. Put the plates outside on a window ledge or someplace where they will not be blown away. Use the tape or string to secure the plates. Leave the plates outside for at least one week. The students should compare their findings from the plates.

3. The students also can perform this experiment in different locations. The plates could be left in the classroom, near the street, near or in a home, in a park, by a factory or grain elevator, etc. The groups of students should record their findings at each of the different locations and compare the differences or similarities of all the paper plates.

4. The observation of particulate matter can be enhanced by the use of the microscope. Instead of using paper plates, follow the same procedure with microscope slides. Viewing the slides under the microscope will enable the students to see size, color, and quantity differences more closely.

Water Activity

All About Zebra Mussels

Objective - Students will be able to identify zebra mussels, follow their invasion in Illinois, identify locations where zebra mussels can be found, and do calculations concerning zebra mussel size.

Method - Students use observation, geography, mapping, and mathematical skills to learn abour zebra mussels.

Background - The zebra mussel is a bottom-dwelling mussel that is native to Europe. Its name comes from the striped pattern on its shell. These mussels are invading Illinois waters. Even though they are less than two inches in size, they can live up to five years and will attach to almost any hard surface. Zebra mussels look like small clams with a yellowish and/or brownish "D"-shaped shell, usually with dark and light bands of color. Most native mussels are more rounded in shape and lack a distinct striped shell pattern.

Materials - Diagram of a zebra mussel vs. native mussel
State of Illinois worksheets
Illinois road maps
Zebra Mussels Really Get Around! worksheets

Procedure -

1. Discuss the section, "Zebra Mussel Alert!," found in Chapter 3 of the education packet.

2. Show the students the diagrams of the zebra mussel and the native mussel. Ask the students to indicate the differences between the two diagrams, which will help them identify zebra mussels (shape, size, color, patterns, etc.).

3. Distribute the State of Illinois worksheet, which identifies interstate highways in Illinois and some major rivers and cities in the state, and Illinois road maps. The students should be divided into groups and by using the Illinois road map, must identify the rivers and Great Lake in Illinois where zebra mussels have been found.

4. Explain to the students that zebra mussels can be found attached to many objects (such as boats) that are associated with rivers and lakes. The groups of students should complete the *Zebra Mussels Really Get Around!* worksheet. The students also can color the worksheet for classroom display. (See end of activity for answers to worksheet.)

5. Explain to the students that zebra mussels are small in size, but they can cause big problems since they reproduce and spread rapidly. Explain to the

students that for this activity they will use the measurement, two inches, for zebra mussel length. Students will, while still in their groups, do some mussel calculations. The students will calculate how many zebra mussels, when placed end-to-end, will occupy a given space. Students will have to measure the length of a textbook, desk, chalkboard, classroom, etc. and then they will calculate (using two inches as the standard measurement) how many zebra mussels would cover the length of that object or space. You may think of other objects that the students can measure.

6. Explain to the students that zebra mussels have spread from the northern tip of Illinois to the southern tip of the state since they were first discovered in the United States in 1988. Using the Illinois road map, have the students measure and calculate how many miles the zebra mussels have spread. Use the scale on the Illinois road map for your work. Students should measure 1) from Chicago, Illinois, on the Chicago River to the Illinois River's southern tip at Grafton, Illinois, 2) from Grafton, Illinois, where the Illinois River meets the Mississippi River to where the Mississippi River meets the Ohio River near Cairo, Illinois.

1) approximately 300 miles
2) approximately 215 miles

7. The groups can share their worksheet answers with the class and discuss what they have learned about zebra mussels.

State of Illinois worksheet answers:

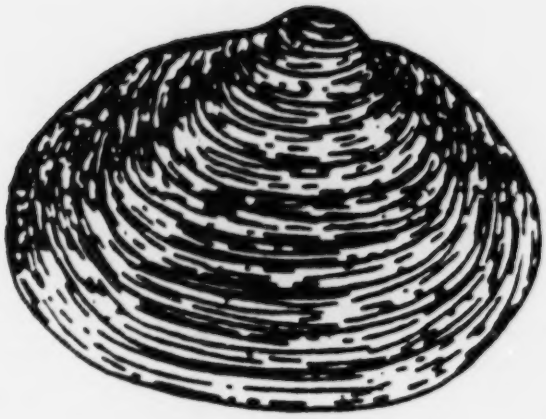
1. Lake Michigan 2. Mississippi River 3. Illinois River 4. Ohio River

Zebra Mussels Really Get Around! Worksheet answers:

6 Park fountain	4 Boat engine	8 Rural fire fighters
12 Fish spawning area	2 Boat trailer	1 Boat hull
10 Bait bucket	11 Native mussels	9 Cleaning exposed boat
13 Swimming beach	7 Water supply pipes	14 Irrigation pipes
5 Water intake	3 Boat bilge	

Handout

Mussel Diagrams

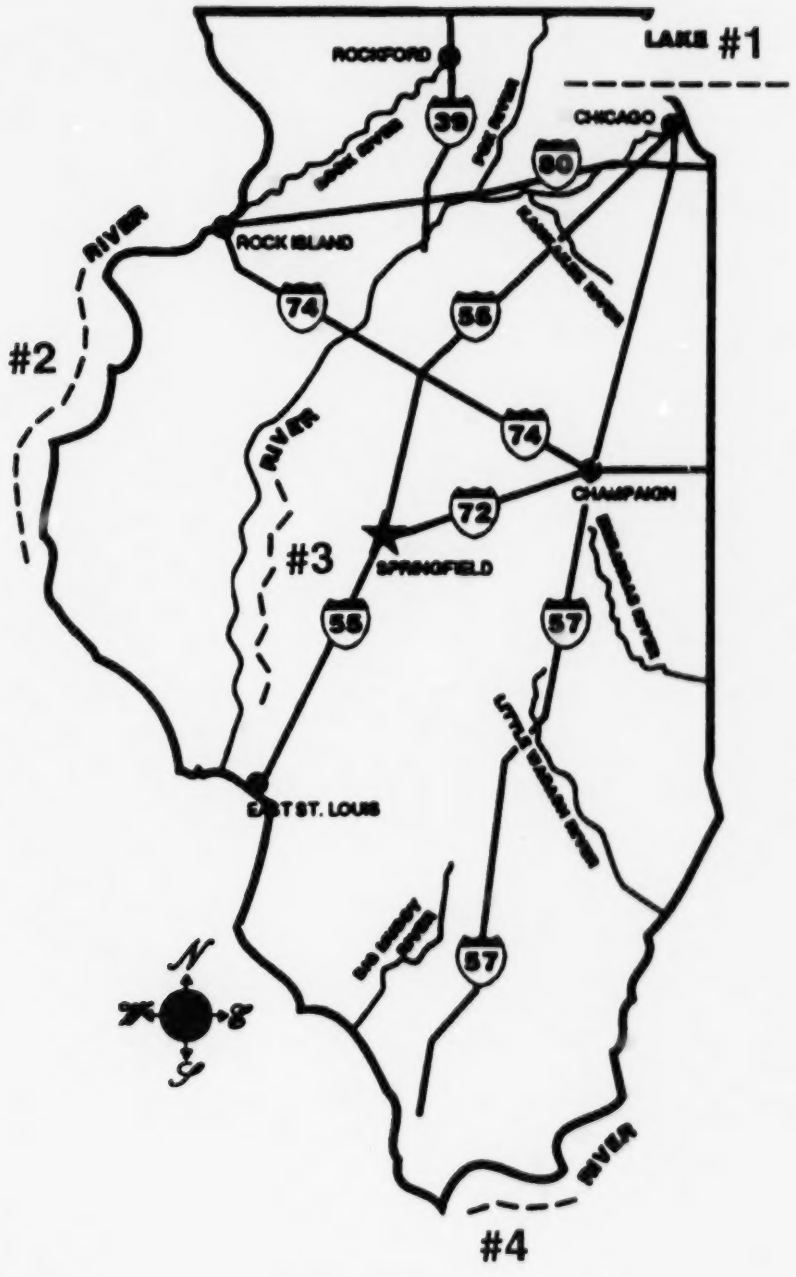


Native Mussel

Zebra Mussel

State of Illinois Worksheet

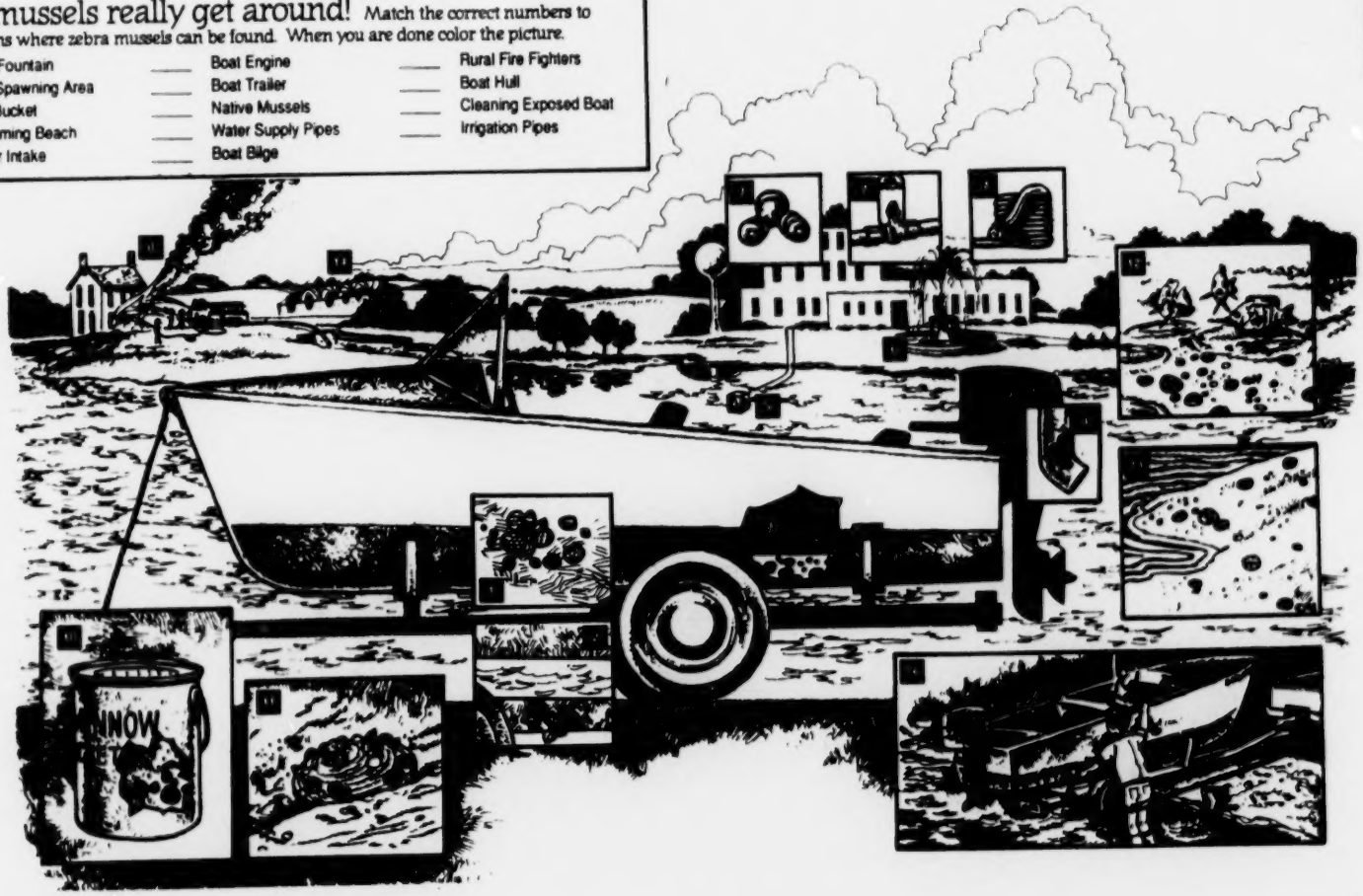
Directions:
Can you identify the three rivers and the one lake where Zebra mussels have been found in Illinois. These four water bodies are identified with dotted lines; write your answers on these dotted lines.



Worksheet

Zebra mussels really get around! Match the correct numbers to these locations where zebra mussels can be found. When you are done color the picture.

____ Park Fountain	____ Boat Engine	____ Rural Fire Fighters
____ Fish Spawning Area	____ Boat Trailer	____ Boat Hull
____ Bait Bucket	____ Native Mussels	____ Cleaning Exposed Boat
____ Swimming Beach	____ Water Supply Pipes	____ Irrigation Pipes
____ Water Intake	____ Boat Bilge	



Land Activity

Common Household Hazardous Waste

Objective - Students will be able to identify common household products that contain hazardous waste properties.

Method - Students take a multiple choice test and use science and research skills.

Background - Many of the items we use every day can become hazardous wastes if they are disposed of improperly. Hazardous wastes can be classified as being **ignitable** if they can catch on fire and burn; **corrosive** if they eat away the containers which hold them; **reactive** if they can explode; and **toxic** if they are poisonous. Of course, some wastes can be in more than one category. For example, fingernail polish remover is both ignitable and toxic.

Procedure:

1. On the Common Household Hazardous Waste worksheet, place an **I** next to the item if it is ignitable, **C** if it is corrosive, **R** if it is reactive, or **T** if it is toxic. Some items may have more than one letter. (If you have some of these items at home, it may help the students to take the list home first. Then, the students can read the labels on the products and can complete the worksheet in groups or as a class at school.)

2. Students should discuss their answers and ask questions about products that they are unsure of their hazardous waste properties.

ANSWER KEY

C,T	1. car battery
R	2. shaving cream can
T,I	3. used motor oil
R	4. empty spray paint can
C,T	5. drain cleaner
R,I	6. unused matches
I	7. used match
T	8. flea killer collar for pets
T	9. rug spot remover
C,T	10. flashlight battery

Common Household Hazardous Wastes

WORKSHEET

DIRECTIONS: Place an **I** next to the item if it is ignitable, **C** if it is corrosive, **R** if it is reactive, or **T** if it is toxic. Some items may have more than one letter.

_____1. car battery

_____2. shaving cream can

_____3. used motor oil

_____4. empty spray paint can

_____5. drain cleaner

_____6. unused matches

_____7. used match

_____8. flea collar for pets

_____9. rug spot remover

_____10. flashlight battery

Air Activity

Air Pollution at Work

Objective - Students will see air pollution at work as smoke discolors a glass lid.

Method - Students will use science and observation skills.

Background - Air pollution is the addition of harmful things to the air. These harmful things are called pollutants and they come from many sources. Even you cause pollution. School buses and cars produce fumes that go into the air. The factories that made your desks and the material for your family's car produce more pollutants. Still more of these pollutants come from things that people do everyday. Here is a list of common things that pollute the air:

- Burning paper, leaves, and garbage.
- Heating homes with coal and oil.
- Running air conditioners.
- Smoking cigarettes, pipes, and cigars.
- Flying airplanes.
- Using motor boats.
- Driving on dirt roads.
- Tearing down buildings.
- Barbecuing in our backyards.
- Driving cars, trucks, and motorcycles.

All of these activities add to air pollution. Sometimes you can smell or see the air pollution.

Materials - Candle
Matches
Potholder
Glass or Pyrex lid

Procedure -

1. Light a candle in the classroom. Ask a volunteer to blow out the flame on the candle. Watch the smoke float through the air. Discuss where it goes.

2. Next, light the candle again. Hold the glass or Pyrex lid over the flame. The teacher should be the one to hold the lid; be sure to use the potholder.

3. After a few minutes you will notice a black spot forming on the lid. As the candle burned it released gases such as carbon dioxide and sulfur dioxide (pollution) that settled on the glass.

Water Activity

Down the Drain

Objective- To help students understand that their actions can make a difference in the quality of water in Illinois.

Method- Students use social studies, language arts, and problem-solving skills to study water.

Background- Rainwater, melting snow, and water from garden hoses can easily wash engine oil, lawn fertilizer, litter, and other matter into gutters and storm sewers, and, finally, into ponds, lakes, rivers, or the sea. Such runoff, of course, also sometimes seeps directly into the ground or washes straight into streams, wetlands, and other surface water. This pollutes surface water and groundwater and poses risks to human beings as well as to aquatic plants and animals. Children and their families can make a difference by properly disposing of litter and other forms of waste. (The pollution described above is called nonpoint source pollution. An example of a nonpoint source pollution is runoff from streets and fields. Nonpoint source pollution is discussed in Chapter 3 and 5 of the education packet.)

Materials- *Down the Drain* illustrated diagram
Pencils
Coloring materials (markers, crayons, or colored pencils)

Procedure-

1. Distribute copies of the *Down the Drain* illustration. Tape an extra copy (enlarged, if possible) to the board. Explain to the children that you will read them a story about the town they see in the picture.

2. Read the story aloud. After you finish each section, ask students to find the scene of the action in the illustration. Ask them to point out the route of the pollutants (oil, fertilizer, and trash) described in the story. They will discover that, in each case, the pollutants make their way into the street, then into the storm drain, and finally into the river. Have students color in each scene and indicate the path of the pollutants into the river.

3. *Andrew and Emily Learn About Keeping Water Clean.*

It was a bright, sunny Saturday morning. Andrew and Emily were already dressed and ready to go to the playground by eight o'clock. But Dad had other plans. "Hey, you two," said Dad, "How about helping me change the oil in the car. Come on out here and I'll show you how to do it!"

"But we wanted to go to the playground!" Emily said.

"Plenty of time for that later," Dad said.

Soon, all three were on their hands and knees, watching the thick, dirty oil pour out into a pan. Once the oil had drained, Andrew

poured the new, clean oil into the engine through a funnel. Then Dad carried the pan of dirty oil to the curb and poured the oil down the storm drain.

When Dad returned to the car, Emily closed the hood.

"There!" said Dad. "Good job! Thanks for your help!"

(Stop for discussion. Did Dad dispose of the oil properly? Pouring oil down a storm drain significantly pollutes local waters, posing risks to animal and plant life. One quart of oil can contaminate as much as two million gallons of water and cars generally hold at least four quarts of oil. Used oil should be taken in a container to an oil recycling center. Many gas stations have recycling bins for used oil.)

Emily and Andrew waved goodbye to their dad and set off toward the playground. But their mom had other ideas.

"Hey, you two," said Mom. "I could really use your help here in the garden."

"But we're going to the playground!" said Andrew.

"Plenty of time for that later," Mom answered. "Come on, I'll show you how we can make the vegetables grow really big!"

In a short time, she had sprinkled powdery fertilizer around on the garden.

"Now why don't you two water the garden," Mom said. "I don't think it's really going to rain today."

Andrew found the garden hose in the driveway. He turned the water on full blast and watered the garden for quite a while. With all that water, some ran off the sloping garden and into the street.

"Thanks for your help," said Mom. "Now you can go to the playground."

(Stop for discussion. Fertilizers contain nutrients that encourage too much growth of algae and other aquatic plants when the fertilizers wash into the local water supply. As the plants die and decay, the process of decay uses up oxygen in the water, depriving fish of the oxygen they need. Thus, fertilizer should be used in moderate amounts. It should not be overwatered and should not be used just before heavy rain. An alternative is to use organic, nonchemical fertilizers.)

Finally, Emily and Andrew got to the playground. They hurried to the jungle gym, where Bill and Sara hung out most Saturdays. Sure enough, there were Bill and Sara on the jungle gym, drinking sodas and munching on candy bars.

"Want a soda or something?" asked Bill. "We decided to spend our whole allowance on this stuff."

"Sure," said Emily and Andrew. They pulled the last two sodas out of the six-pack ring.

"Where should I put this six-pack holder?" asked Emily.

"Don't worry about it," said Sara. "Just drop it on the ground."

"Same with the candy wrapper?" asked Andrew.

"Yeah, I guess so," answered Sara.

Andrew and Emily dropped their trash on the ground and joined their friends on the bars. They ate and drank and played. Suddenly, Emily asked,

"Didn't you just feel a raindrop?"

"Oh, yeah," said Sara. "Maybe we should get home."

In just a moment, a black cloud swooped over them and rain came pouring down. As all four children ran for home, the candy wrappers and the six-pack holder washed away.

Later that day the sun came out again. The school yard looked as good as new. In the muddy garden, the early flowers were just beginning to bloom. The driveway was sparkly clean.

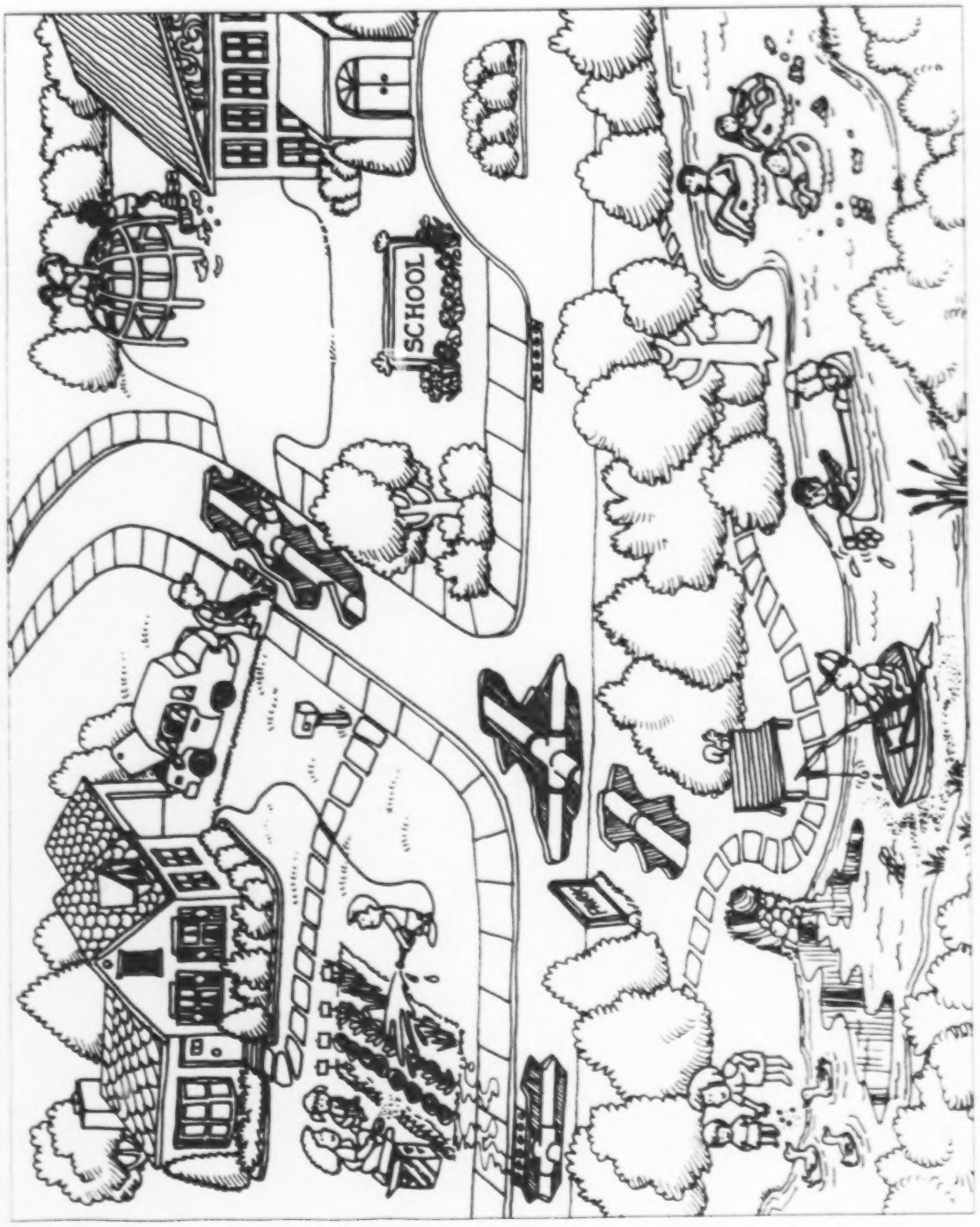
(Stop for discussion. What should the children have done differently? Litter routinely gets washed into local waters, where it constitutes an unsightly blemish - as it does on river and stream banks, shorelines, and beaches. Shiny or plastic litter may be eaten by fish or other aquatic animals, injuring or killing them. And six–pack holders, in particular, frequently entrap aquatic animals or birds in their rings or small openings. In addition, trash pollutes the water. Many people are unaware of the amount of litter on city streets that ends up in local water supplies - as it does in this story.)

4. After discussing each section, students will find that, even though pollution comes in different forms and from different places, it may all end up in the same place down the drain and in the water, where it threatens someone else's future water supply, or their own, and poses threats to wildlife and plant life.

Ask students: How could Andrew and Emily have made a difference in keeping the water clean? Do you or your family ever pollute the water? How can you help keep the water clean?

Handout

Down the Drain



Land Activity

If You Know the Code ... You Can Identify What Resin the Plastic is Made From.

Objective - Students will be able to identify seven types of plastic, materials they are made from, and their uses.

Method - Students will collect and display seven different types of plastics, using the code on the container. Students will use science and social studies skills.

Background - To make recycling easier, plastics manufacturers are now using a standard coding system on plastic containers to identify the type of plastic resin they are made from. Plastic resins are made from oil. Since plastic recycling opportunities are different throughout the state, consumers should find out which types of plastics are recycled in their communities and purchase products that are made from those types of plastics.

Procedure -

1. Find an example (milk jug, etc.) of each of the seven plastic types. (Use the handout: If You Know the Code.)

2. Make a list of what product is in each of the containers (soda, butter, etc.).

3. Find out which plastics are recycled in your community. (Handout: If You Know the Code)

4. Discuss:

How plastics are made.

Where do the resins come from?

Is oil a renewable resource?

What happens to plastics that are not recycled?

How can the plastic containers found by the class be reused?

Handout

If You Know the Code

Plastic Container Code System For Plastic Containers

	CODE	MATERIAL	TYPICAL PRODUCTS
	Pete	Polyethylene terephthalate (PET)	soft drink bottles
	HDPE	High-density polyethylene	milk jugs, laundry detergent
	V	Vinyl/polyvinyl chloride (PVC)	vegetable oil bottles
	LDPE	Low-density	dry cleaning bags, bread bag
	PP	Polypropylene	yogurt cups
	PS	Polystyrene	carry-out containers
	Other	All other resins and layered multimaterial	microwavable serving ware

Air Activity

How to Plant a Tree

Objective - Students will learn how to plant a tree and about the importance of planting and caring for trees.

Method - Students will use their science skills of observation and analysis, and they will learn about and use the techniques of tree planting.

Background - Trees are the biggest member of the plant kingdom. If you go to a park, you will probably see several different types of trees. If you look out the window, you will probably see a tree. Trees can grow in the city as well as the country. They provide shade during the summer and beauty in the fall when their colors change to yellow, bright orange, or red. Some trees give us delicious fresh fruit like apples, pears and cherries. In addition, trees provide a living area for birds and animals like squirrels. Most importantly, trees clean the air. Through a complex chemical reaction, trees absorb carbon dioxide and give off oxygen.

Materials - *How to Plant a Tree* worksheets
Tree sapling (donated or purchased)
Shovel
Mulch
Hose or watering cans

Procedure -

1. Discuss with students the importance of planting trees and why they must be taken care of until they are sturdy members of the plant kingdom.

2. Divide up the tree planting process among as many students as possible. If you can, obtain more than one tree, so that more students can participate.

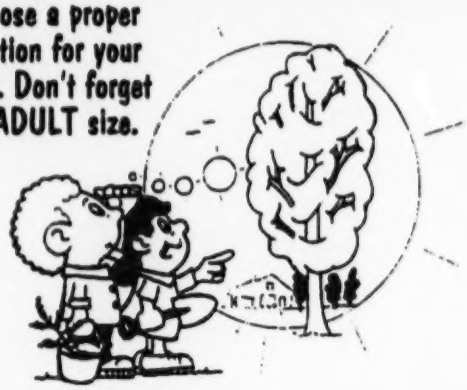
3. Give each student a copy of the *How to Plant a Tree* worksheet. Review the worksheet before you take your tree(s) outside and plant it in the ground.

4. Encourage the students to continue to take care of the tree.

5. Designate a different student each week to water the tree and to make observations of how the tree has changed (new leaves in the spring, taller, larger in diameter, bird nest, scars, fall leaves, etc.)

How To Plant A Tree

1. Choose a proper location for your tree. Don't forget its ADULT size.



2. Keep your roots moist at all times. Dry roots die.

3. Dig a hole large enough to spread the roots apart.

4. Place the tree in the hole at the proper depth. (See below.) Gently add loose soil.

5. Add more soil and firm with foot.

6. Mulch with wood chips.

7. Water regularly. Wait for shade!

How Deep?

Too Deep. Too shallow. Just right.

Water Activity

One Cup's Enough

Objective - Students will conserve water while brushing their teeth, encourage their families to conserve water, and calculate how much water could be saved in the state of Illinois if everyone brushed their teeth with a cup of water.

Method - Students investigate water conservation through scientific experimentation and mathematical calculations.

Background - Water is a very important part of our daily lives. Humans have a variety of choices in terms of how we use and treat water and how much water we use. In our lives we can make decisions to use water with respect and care. We can conserve water as part of our daily lifestyle.

Water issues are gaining greater attention in our state and throughout the United States as communities are facing problems with both the quantity and quality of their water supply. This activity develops awareness of how humans use water.

Materials - Toothbrushes (Students bring toothbrushes from home; also have a few new toothbrushes available)

- Toothpaste
- Cups
- Water
- Sink
- Bowl
- *Brushing Up in Illinois* worksheets

Procedure -

1. Discuss "Be Water Wise" from Chapter 5 of the education packet.

2. Ask for a volunteer to demonstrate how you should not brush your teeth by letting the water run continuously.

3. Ask for a volunteer to demonstrate for the class how one can use only one cup of water and still do a good job of brushing your teeth.

4. Each student will get a chance to participate in the activity and use only one cup of water to brush their teeth. (Suggestion - The activity can be done following lunch.)

5. Encourage the students to continue this activity at home and to include their families.
6. Have the students calculate either individually, in groups, or as a class how much water could be saved in Illinois if everyone used only one cup of water to brush their teeth. When we let the water run, we can use up to one gallon of water when we brush our teeth. Use the *Brushing Up in Illinois* worksheet.

7. Ask the students if they participated in the activity at home; if their family participated in the activity; and did the students calculate the water saved?

8. Students also can calculate how much water would be saved in the state of Illinois, or by their family, if they did the activity for a week, a month, a year; or water savings can be calculated based on class participation or school participation.

Brushing Up in Illinois

WORKSHEET

Part A. If each person in Illinois used one gallon of water each time they brush their teeth.

Illinois population: 11,500,000 people

Brush twice a day: x 2

Water used each day in Illinois to brush teeth: _____ gallons

(Answer A)

Part B. If each person in Illinois used one cup of water each time they brush their teeth.

Illinois population: 11,500,000 people

Brush twice a day: x 2

Water could be used each day in Illinois to brush teeth: _____ cups

(Answer B)

Part C. Remember, 16 cups = 1 gallon.

23,000,000 cups = _____gallons

(Answer B) **(Answer C)**

Part D.

_____gallons - _____gallons = _____gallons

(Answer A) **(Answer C)** **(Answer D)**

Answer D = How many gallons of water would be saved each day in Illinois if we used one cup of water vs. one gallon of water to brush our teeth.

Land Activity

Litter Patrol

Objective - Students will go on litter patrol to rid the school yard or neighboring area of litter.

Method - Students learn by using social studies skills how litter can be an unnecessary activity that requires cleanup and will discover that many of the items carelessly tossed are recyclable.

Background - Littering is thoughtless disposal of waste. Litter can be found all over our land. It is often seen along roadways, in forests and streams and in parks and streets. Litter is land pollution. It is an ugly contamination of natural areas and a threat to wildlife, plants and humans. Two percent of our country's solid waste ends up as litter. The only cause of litter is careless people. Tossing something out of a car window or on the street is a bad habit. Luckily, we can change our attitude and habits and stop littering which will help reduce the amount of garbage we see lying around.

Procedure -

1. Students will be given a "treasure" litter list of things to look for on the school grounds, park, etc. The students can be divided into groups or work individually. An example of a treasure list is on the next page. Explain to the students that they also should pick up litter that is not on their list.

2. After litter patrol returns with their containers of waste, inventory the items.

3. Discuss what items were found. Ask the students the following questions:

   - How could any of these items been reused?

   - How could any of these items been recycled?

   - Which items are difficult to reuse or recycle? Why?

   - If these items had not been discarded as litter, where should they have been disposed of properly?

   -What litter do you see in other places in your community?

4. Have the students brainstorm about what each of us can do to reduce the amount of litter.

"Treasure" Litter List

1. aluminum cans
2. something blue
3. candy or gum wrapper
4. pencil
5. ink pen
6. something plastic
7. something round
8. six-pack holder
9. paper
10. something metal
11. a glass container
12. a part from a car

Land Activity

Making Paper

Objective - Students will be able to make their own paper.

Method - Students use art, science and social studies skills to recycle paper into pulp and make a piece of recycled paper.

Materials - Ten pieces of tissue or newsprint.
A piece of screen
A flat dish (a little larger than the screen)
Four pieces of blotting paper the size of the screen
A bowl
An egg beater (a blender works better)
A round jar or rolling pin
Newspaper and blotter paper
Two cups of hot water
Two teaspoons of instant starch

Procedure -

1. Tear the paper into very small bits into the bowl.

2. Pour in the hot water. (For fancy paper, you can add glitter to the paper mixture.)

3. Beat the tissue and water to make pulp.

4. Mix in the starch.

5. Pour the mixture into the flat dish.

6. Slide the screen into the bottom of the dish and move it around until it is evenly covered with pulp.

7. Lift the screen out carefully. Hold it level and let it drain for a minute.

8. Put the screen, pulp side up, on a blotter on some newspaper. Put another blotter over the pulp and more newspaper over that.

9. Roll the jar, or rolling pin over the "sandwich" to squeeze out the rest of the water.

10. Take off the top newspaper. Turn the blotter "sandwich" over so that the screen is on the top. Then take off the blotter and the screen very carefully. Don't move the pulp. There is your paper.

11. Put a dry blotter on the pulp and let it dry.

Guide for Recycling in Schools

There are a lot of good reasons to recycle! Recycling saves energy and resources, saves room in our landfills, reduces pollution, keeps down disposal rates and provides materials for new products. A school recycling program can accomplish some additional objectives:

1. It is an effective hands-on approach to environmental education and helps students develop environmental knowledge and values.
2. A school can save money by reducing the amount of garbage that needs to be collected for disposal.
3. A school might make money from the sale of collected materials.
4. Finally, a school recycling project can provide an important public service by serving as a recycling depot for the surrounding neighborhood. (The depot could be either a 24-hour drop-off point or a once-a-month depot, depending upon the facilities.)

When planning an in-school recycling program it is important to establish priorities. Decisions will be easier to make if participants are clear about what they are trying to accomplish.

What a school decides to recycle will depend on what is currently being thrown away and what markets are available to handle the collected items. Most schools beginning to recycle will find that paper is the most abundant material to collect. Mixed scrap (unsorted paper of all kinds) has limited reuse potential and is therefore difficult to market, so keeping ledger (high-grade stationery type paper), kraft (paper sacks and heavy postal wrapping) and newsprint separated will mean better marketability.

Other recyclable items a school might generate include: glass, aluminum, corrugated cardboard and tin cans. Whatever is to be recycled must be separated into types (glass with glass, cardboard with cardboard, etc.) Items such as slick advertisements and magazines, waxed paper, carbon paper, paper labels on cans, sticky "Post-It" notes, food, and gum cannot be recycled. For the proper preparation of each collected item, check with the people who will be collecting and/or marketing your materials.

A school recycling program may be organized by:

1. the school district administration,
2. the school's administration,
3. the student council,
4. a teacher,
5. a school class or grade,
6. a student, teacher or parent group,
7. a community recycling project not directly connected with the school.

Depending on the age or grade level, students can be in charge of most or all aspects of the program. It is important that project organizers work closely with the custodial and clerical staffs from the beginning. Cooperation from them is essential for the success of the program. A well run program should not involve any increase in the workload of either the custodial or clerical staff.

Organizing the Program

1. Identify a competent person to serve as coordinator for the effort. The commitment of this person is central to the success of the effort.

2. Have students conduct a study to determine the type and amount of items which are currently thrown away in the school. This will be important in determining what to recycle and in negotiating with collectors and/or markets.

3. Have students conduct an area market study. Are there markets for your potential recyclables?

   a. Dealing directly with markets will mean a larger potential profit for the school.

   b. Deal with an established community recycling project which will collect and market the materials for you. This may mean less profit for the school, but would greatly reduce the time spent managing the program.

4. Establish a planning group made up of representatives of each group that will be affected by the recycling program - students, teachers, administrators, clerical personnel and custodial staff. They will need to evaluate the studies conducted by the students to determine the feasibility of setting up a recycling program. Some of the questions they will need to answer are:

   a. What are the goals of the recycling program, and what is the priority of each goal? (i.e., to provide hands-on recycling experience for students, to make money, to reduce school waste, to provide a community service, etc.)

   b. What items should be recycled (aluminum, glass, paper, newspaper, plastic, etc.)?

   c. Where are the recyclable items generated? (Classroom, offices, cafeteria, etc.)

   d. What currently happens to the items?

   e. What alternatives are there for separation, collection, storage and transportation? What alternatives are best?

   f. What problems can be anticipated?

   g. What codes need to be considered? (i.e., health, fire, safety, etc.) Work with your group and officials to find workable ways to meet these codes.

5. Lastly, a schoolwide education program should be planned and implemented to ensure that everyone understands the recycling procedures and to motivate as many people as possible to participate. This is a key step. Even the best programs will fail if there is not a commitment from the people involved.

Some of the following activities may be used in this publicity/education effort. Have students:

- Design and make posters dealing with why and how to recycle.
- Design and make containers for collection of recyclables. These might be made out of 55 gallon metal drums or heavy cardboard boxes.
- Participate in contests between classrooms, grades or schools to stimulate involvement.
- Explore imformation and concepts about recycling in social studies, science, economics and mathematics classes.
- Do a research project related to recycling: energy savings from recycling, composition studies of samples of solid waste, recycling industries in the areas, etc.
- Survey the community to determine why some people recycle and others do not.
- Do art projects using waste materials.
- Go on field trips to local recycling centers and industries.